SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*KNOW, THEN, THYSELF.**

LONG ago, as history measures time, when our planet was regarded as a flat disk girt by an unknown sea, and heaven was no farther away than the fair summit of Mount Olympus; when learning centered about the eastern curve of the Mediterranean, and a knowledge of music, mathematics and philosophy constituted a liberal education, a master mind emphasized the seemingly simple precept, 'Know thyself.'

Centuries later, when the disk had rounded into a sphere; when Jehovah had superseded Jove; when civilization had become continental; when the classics, modern languages and literature had been added to the list of scholarly pursuits, a keen little Englishman echoed the injunction of the ancient Greek.

And to-day, when scientific research has extended beyond the confines of the habitable portion of the earth, invaded the depths of the sea, explored the uttermost heights of the atmosphere and mapped the heavens; when God is worshipped as a spirit and ever more reverently as we begin to comprehend the marvels of his creation; when the making of many books has given this knowledge entrance through every door open to receive it, how much more reason have we than had Alexander Pope to re-

* Address of President of American Folk-lore Society at annual meeting, Chicago, January 1, 1902.

echo the advice of the sage of old, 'Know thyself.'

Man may boast that he has conquered a universe, but what does he know about his own nature? He began to study it but a little more than a generation ago, when the publication of the 'Origin of Species' and the confirmation of the conclusions of Boucher de Perthes rendered possible the organization of the science of man.

Instead of a few individual writers and an occasional investigator there is now a well-trained corps of anthropologists. Active national societies have been formed, costly laboratories are maintained, and excellent journals are published. The science is taught in the leading universities of most civilized countries: in the United States some degree of instruction in it is offered in thirty colleges. It has seemed to me worth while to set forth my reasons for believing that anthropology should be taught in every college in America, both because of the information it imparts and the discipline it gives.

As a branch of education, anthropology has passed the pioneer period. In some of our older institutions, where instruction in it has been given for more than ten years, the number of instructors and students is continuously increasing. Always offered as an elective, anthropology has thus demonstrated its ability to win its way.

As an objection to the introduction of this new science it is sometimes said that college curricula are already crowded. But with the rapidly extending elective system the number of courses offered far exceeds the time limit of any individual. At Harvard, for example, the undergraduate might study one hundred years before obtaining his bachelor's degree if he took all the courses open to him. I presume that the authorities of our universities of a hundred and fifty years ago would have considered their curricula threatened by an appalling congestion if to the subjects of that time had been added simply the increase of courses due to the present status of knowledge in those branches. And yet, besides all these, additional departments—electricity, biology, psychology—have been admitted, not only enriching the schedule of studies, but winning prominent rank therein. Similarly, anthropology, 'the crown and completion' of the sciences, is assuming its rightful place; and I shall endeavor to show why it may be added with special advantage to even a crowded curriculum.

Since anthropology has become clearly defined we hear fewer protests that it embraces too much. Its very comprehensiveness is a virtue; for thereby it is rendered suitable to serve as a framework for all other knowledge whatsoever, a symmetrical framework, lacking which the student but too often builds a series of mental watertight compartments, so to say, that give no unity or harmony to the intellectual edifice.

Mathematics, for example, though a discipline study based upon necessary reasoning and thus perhaps the most remote from anthropology, nevertheless finds its appropriate place in this ideal educational structure. The anthropologic student learns that among some peoples the mastery of the number concept does not extend beyond the ability to count two or three; that all grades of mathematical comprehension exist from this primitive condition up to our own denary system. He learns that culture may be most profoundly influenced by the reaction of the number concept upon human thought. The basic number may determine the number of gods that are selected to rule; through the calendar it influences agriculture, and, indeed, most of the industrial arts; it affects the pleasures and religious ceremonies of the people. Wherefore I maintain that the addition of the 'human touch' to mathematics gives

new meaning to the limited portion of the science with which the average student is acquainted.

In the case of geology the relation to anthropology is more obvious. With the general outlines of geology, the earth building processes, the sequence of strata, and the like, the student is familiar before he takes up the study of anthropology. Passing over the rapidly increasing importance of the economic uses of geologic materials from mine and quarry, we observe that the later geologic periods are of supreme interest in the discussion of the great problems of the time and place of man's origin. Back to the confines of the tertiary we have traced the remains of man and his handiwork, and beyond that barrier we are constantly hoping to pass. Therefore, at each new archeologic discovery the question of geologic age must be answered. After these primal problems come those of the distribution of mankind during the glacial and other cosmic changes. At other points in geology the 'human relation' is likewise established, and without it the allied sciences, geography and meteorology, would be poor indeed.

Permit me to cite one more example, drawn, not from the sciences, but from beliefs. During his course in anthropology the student receives instruction in the so-called 'science of religion,' studying it wholly as a product of human thought or imagination. It is a revelation to him to discover the vital part religion has played in the history of the human race. He learns that religion dictates to millions of his fellow creatures what they shall eat and drink, what they shall wear, how they shall work and how they shall play, what they shall think about, and some things about which they may not even think. Says Brinton of the savage, "From birth to death, but especially during adult years, his daily actions are governed by ceremonial laws of the severest, often the most irksome and painful, character. He has no independent action or code of conduct, and is a very slave to the conditions which such laws create." Not only among savages does this intimate connection between religion and all other elements of culture manifest itself, but also in all other grades of development, in all times and places. He must have breadth of view who realizes the significance of it. The theological student, however liberal, views but one side; the art student sees little more than the influence of religion upon painting or architecture or music; the sociologist deals primarily with Caucasian culture; the anthropologist alone investigates religion impartially in relation to other phases of thought.

Furthermore, the erection of this framework brings before the attention of the student the rooms that are incomplete and vacant, so that he may set about furnishing them. With this guidance he will study modern geography, with its complete survey of environment and life; comparative religion, with its breadth of view; the fine arts, as the highest expression of universal feeling; history which he will approach with a correct sense of proportions and time relations. For he will see that the adoption of the first articulate word by man, as distinguished from the mere animal cry of his ancestors, was an event of infinitely greater importance than the foundation of the Roman Empire; that the discovery of the art of kindling fire was vastly more significant in history than the battle of Tours.

Modern anthropology does not formulate theories from travelers' tales nor indulge in metaphysical speculations. It proceeds to its conclusions by the scientific method of direct observation and experiment, a method that is obtaining so much popularity that most students desire some acquaintance with it. By proper training

in any of the natural sciences this knowledge may be acquired, but it frequently happens that students having no taste for these branches will not take them under the elective system. Thus they may be graduated with an excellent store of linguistic, literary or mathematical information, and yet be sadly deficient in the power of observation and of correct inference, important requisites for success in this workaday world. To such students anthropology opens a new field. He who may abhor the smell of zoological specimens and the sight of laboratory dissections will, perhaps, take kindly to the examination of fictile objects, or textiles, or the various other art products that we study to determine the cultural status of this or that group of men, or for the purpose of tracing the course of industrial or æsthetic development. He who may be indifferent to the wonders revealed by the lens of the botanist may engage with enthusiasm in research relating to the music, mythology or ceremonies of alien peoples. He whose interest is not held by the marvelous story of geology fixed in lifeless stone may be zealous in the study of living humanity.

Among his fellows the anthropologist finds abundant opportunity for cultivating his powers of observation. After studying the problems of heredity, miscegenation, degeneracy, and the like, it becomes an instinct with him to note the color of hair and eyes, the shape of the head and face, and other individual peculiarities of those around him. A friend tells me that he relieves the tedium of a long examination of which he may have charge by tabulating statistics concerning the busy writers before him; how many are left-handed, part their hair in the middle, wear glasses, are blonds or brunettes and the like. Here it is little more than a pastime, but it illustrates the manner in which the habit of observation is fixed.

In the field the anthropologic investigator quickly discovers that to record accurately requires the keenest watchfulness. Let us suppose that we are witnessing the annual festival of the Jicarilla Apaches. The event is the relay race. The runners are marching in column through the surging mass of spectators. Drums are beating, rifles and revolvers are fired, shouts and cries add to the confusion. What is the signal that causes the column to divide? Why do all march to one goal and then half of them march back to the other? Soon the crack of the starter's pistol sends the best runner of each of the two groups down the course on the first relay. The excitement is intense. The walls of the narrow lane down which the brown forms are flitting yield to the pressure from without and threaten to collapse. The observer struggles to obtain a position near the goal. Does the winner touch his successor of the next relay? Does he hand him any object to carry? What is the purpose of these branches of cottonwood that are moved up and down the line? What is the meaning of the tufts of down that are added to the scant attire of the runners? Why are they cooled by spraying their backs from the mouths of their attendants? What are the methods of imparting speed resorted to by the opposing factions? For half an hour the observer hurries from point to point with camera and pencil in hand, and then suddenly the uproar becomes deafening. The race is ended. Offerings of bread, grapes and other fruits from the distant Rio Grande—even watermelons—are thrown from the crowd to the victors. A dozen observers are needed now to complete the account. Indeed, some measure of ubiquity is often longed for by the field-worker. He has every incentive to become proficient in quickness and accuracy of observation.

Again, the student may be so fortunate

as to witness a Maricopa medicine dance. The shaman is in doubt as to the nature of the disease; he must consult the dead for guidance in treatment of it. Followed by his awe stricken friends he approaches a grave, but not too closely, and calls to the resident spirit. Out of the darkness of the night come ghostly whispers in reply. The medicine man grows more confident and emphatic; his followers shrink farther back. To them the dialogue is conclusive evidence of the power of the shaman. To the observer it presents an opportunity for the detection of fraud. Is he clever enough to discover the identity of the confederate? Can he see without seeming to do so?

The nature-quickened keenness of observation of those whom the field investigator studies affords him an example wherefrom he must needs profit. In no other science is the object of research at once an example and also laboratory material. Again and again I have been impressed by the degree of perfection in observation manifested by Indian hunters in all parts of America. Old Peter, the Assiniboine, for example, with whom I hunted big horn in British Columbia, taught me as much about observing as any college professor ever did. Of course I appreciated the fact that his livelihood depended upon the cultivation of this trait, and it was not surprising that he should manifest proficiency in that one line when practically all others were excluded. Peter led the way into the mountains through passes yet choked with the late snows of winter, riding an old cayuse whose speed was not in the least accelerated by the tattoo of Peter's heels on its ribs. A band of green mosquito netting kept Peter's hat-rim against his ears on cold days, and served to protect his eyes on bright ones. But my attention was soon drawn from his attire to the skill with which he read the half obliterated signs. I could see the tracks as well as he, but I could not follow a single one through a maze as complicated, apparently, as the crowded street through which the dog trails his master with unerring swiftness.

Contrast with Peter's keenness the lack of it exhibited by the Gila freighter, who had made a dozen trips to Tempe, and yet wagered his team that the butte that overlooks the town was on the left as one approaches the place. There are no hills to confuse one's memory within twenty miles along that road, so that he had no excuse to offer, no word to say, when he found the butte on his right as he entered Tempe. He simply left the team and wagon to his more observing companion and walked home.

Incidentally, field research enables the student to travel, and thus add to his resources for happiness throughout life. For it is not alone the viewing of new scenes and new peoples that gives him pleasure, but there is the more lasting enjoyment resulting from the addition of new territory to his literary domain. For example, it is well known that he who visits the realm of arctic frost is ever tempted to return. He also finds the keenest pleasure in reading of the experiences of others in that region of infinite vastness. After the lapse of ten years I feel as deep an interest in that 'Land of Desolation and Death' as when I left it. Again, those who know the great arid Southwest find in its tragic history and in the writings of its pioneer anthropologists a source of perennial pleasure. He who has felt the spell of the desert has added a priceless treasure to his experience. He can sympathize with the belief of the desert dwellers that the wraith-like *remolinos* sending their columns of sand toward the bluest of heavens are not miniature whirlwinds, but spirits of air; that the pillars and other strangely eroded forms of sandstone are the figures of men transfixed there in the early twilight of time; he

himself has felt the clutch of the demon of thirst that camps ever close upon the trail.

The student engaged in field research in archeology can usually find but few facts at best from which to reconstruct the history of the past, and those few are often obscurely hidden in the mud of the swamp or the sand of the desert, where a careless blow of the spade may annihilate the record forever. For example, the shape of ancient wooden implements may be known from the mold of clay in which they decayed; but this form may be destroyed by a single stroke. Many old skulls, also, are so fragile when found that after a few minutes' exposure to the air they crumble to dust. Careful treatment may save some of them, but quick and accurate observation is absolutely necessary.

But correct observation is not the sole requirement for success. It suffices to render a man useful and helpful in minor positions, but ere he can become a leader in thought and action he must have the ability to interpret the data accumulated. In other words, he must develop his reasoning powers, and here again anthropology presents her opportunity. In the domain of culture history, particularly in its genesis, he ventures upon so much controversial ground that he must wield his weapons well in order to pass safely through. It was to this opportunity for diversity of opinion, and the innate bellicose tendency of man, that Huxley attributed the growing popularity of the science a quarter of a century ago. I have found that the presentation in the lecture room of the interjectional, gesture, and other theories of language usually leads to the liveliest discussion with the students, discussions that are sometimes adjourned to the home of the instructor. The ascertainable evidence relating to the origin of beliefs gives rise to widely differing inductions. A venerable friend who is preparing a treatise upon religion told me that he had found sixty-two theories accounting for its origin—and I had the pleasure of calling his attention to a sixty-third. In the examination of any considerable portion of that array of arguments, the student must exercise his judgment to discriminate between the plausible and the reasonable. He aims to discover fundamental principles and laws, and to that end his attitude must be, not credulous, but critical. Folk-lore, too has its debatable problems of myth migration, acculturation and relationship. In the arts opportunities for independent reasoning abound; for example, the student may examine the weapons, utensils and ceremonial objects of a tribe, and by comparison and analysis determine the character and course of development of its decorative art. He may study primitive scales of music, and investigate the theories of Darwin, Spencer, Grosse and others accounting for its origin.

The ethnologic study of technology is by no means the least in its power to stimulate thought. The college student all too frequently loses sight of the importance of the part that manual labor plays in the maintenance of civilization, and is usually ignorant of the extent of its contributions to cultural development. It extends the range of his thoughts to learn of the age-long gropings of his forebears in their discovery of the value of a newly fractured flint as a cutting instrument, and their improvement of it until it became a symmetrical blade. He sees a deeper meaning in the simpler industrial activities as he learns that the training of the muscles reacts upon the brain. The savage who binds a rawhide netting around a rough frame for his snowshoes, finds that the untrimmed edges of the wood soon cut through the leather. He makes many pairs, perhaps, before he

notices that when he scrapes the surface of the wood the lashing wears longer. He derives a sensation of pleasure, also, from the contact of his hand with the smoothed surface, and this gradually develops a mental pleasure at the sight of well-made frames. His skill in cutting and carving increases with practice, so that decoration of implements and weapons becomes possible, or, as we say, 'the manual concepts react upon the æsthetic mental concepts.'

When the student of anthropologic habit of thought contemplates that wonderful product of this industrial age, the ocean liner, he takes it 'by and large.' His mental vision sees beyond it the long line of less and less ambitious craft that terminate with the floating log propelled by a pole, or with the naked hands. Yet more than this: he sees migratory movements probably initiated by the food quest that required the use of boats to cross, now a river, now an arm of the sea. He sees a resulting development of commercial routes forming a vast network, which even in the earliest historic times was the product of centuries of growth and the interplay of forces ultimately environmental. The vista is a long one, and in viewing the evolution of this single industry the student perceives something of the complexity and grandeur of the laws that have moulded the modern arts. And so, because based upon broad lines, and yet balanced by exhaustive special researches, the science of anthropology develops a sane and wholesome mind.

The inherited proclivity of the Anglo-Saxon to despise all non-Caucasians becomes in the anthropologist a passion for studying them. He knows that his self-assumed superiority has its limitations, that his own ancestors in times geologically recent were tattooed cannibals as primitive in habit as the Digger Indians of the Sierras. He knows that his culture is in a measure due to environment, to the chance that led those early immigrants to a continent whose vast extent of shoreline rendered it immeasurably superior to all others as the home of commerce. His people were surrounded by animals capable of domestication, while the American race, for example, was handicapped by their absence.

Not only does the anthropologist take a more modest view of the virtues of the Caucasian, but he also learns to credit the savage and barbarian with many praiseworthy qualities. He finds that our aborigines are more devout than we, their happy family life most exemplary, their patience and courage under the wrongs of border 'civilization' most admirable. This knowledge induces forebearance and respect. Brought into contact with these and other alien races through field research, the anthropologic student discovers that they can estimate his worth with surprising quickness; they may not have heard of the nebular hypothesis, they may be unacquainted with the units of the metric system, but they can take the measure of a man with a glance.

Anthropology, with ever-widening knowledge of the peoples of earth, promises to make real that dream of the poets, the brotherhood of man; not a relationship based upon sickly sentimentality, but a brotherhood resulting from an understanding of the capacities and limitations of our fellow beings. We shall then have appreciation without adulation, toleration not marred by irresponsible indifference nor by an undue sense of superiority. Anthropology leads to a more charitable attitude toward the diverse philosophies of men, dealing as it does with the basic motives of all systems. It induces religious toleration, 'which,' says our greatest of college presidents, 'is the best fruit of the last four centuries.' And yet, although the sun

of enlightenment has absorbed the flood of mediæval religious persecution, we have all seen remnants, noisome pools of intolerance, in localities where the cleansing rays seldom and feebly penetrate. I know of no instrument with a potency equal to that of anthropology for their removal.

The proverbial tendency in the college student toward self-complacency is checked and corrected by a knowledge of the broad lines of cultural development, of the primal principles of all human activities. Vanity cannot thrive in the contemplation of a plan that requires an eternity for its fulfilment. 'Wisdom is before him that hath understanding.'

The somatologist discovers in the human body a record, kept by the vital principle of heredity, of its upward struggle from the simplest animal forms. This living history dates from a past beside which the glacial epoch is but as yesterday, yet it is not vague and indecipherable; it is boldly written. Pages are inscribed in our muscles; others in vein, artery and gland; in the digestive system and the epithelial tracts; and others in that most conservative of tissues—the nervous system. In head, trunk and limbs these functionless 'fossilized structures' abound, not only useless to us now, but positively dangerous, as they frequently become the seat of disease.

In like manner, the folk-lorist finds in the body politic survivals of belief and practice that antedate and supplement written history. Backward they lead through ever simpler social organizations to the primitive period when men walked in the fear of gods innumerable that influenced every waking moment and filled with dread their dreams. Yet farther, and the investigations of the folk-lorist mingle with those of the comparative psychologist along the border line between brute and lowest human. These survivals, also, are a menace to individual welfare, as I doubt not that more than one person will be executed for witchcraft within the boundaries of these United States in this year of grace, 1902. It is not long since a Pima Indian was killed by his fellow villagers in Arizona because he knew how to use a carpenter's spirit-level. With the magic stick he had begun pushing at unheard-of speed the preliminary survey for an irrigating ditch. That night a jury of his peers tried, convicted, and shot this Piman martyr to progress.

Not only the individual, but the tribe or community also, may be injured by the continuance of traditions from a lower cultural stage. 'The power of tradition' is an accepted aphorism. An illustration of the power and possibilities of evil in such a survival is seen in the case of the city of Mexico. Six centuries ago a migrating band of aborigines was led by a myth to select an islet in a stagnant lake as the site of their pueblo, a choice that it is extremely improbable they would otherwise have made. But the eagle with the serpent in his talons alighted on a cactus there, and thus determined the location of Tenochtitlan. The village became a city and throve in material prosperity, but it suffered one serious disadvantage; it was subject to submergence under the waters of the lake, so that protection was sought in a great causeway seven or eight miles in length. Later a drainage canal was begun; as the centuries passed, millions on millions were spent in the work, thousands and hundreds of thousands of peons perished in that ditch. In the mean time, the city of Mexico suffered the odious distinction of having the highest death rate of any capital in the world.

Not alone in its origin, but also in its downfall as the seat of Aztec power, did this city illustrate the effect upon the community of traditional belief. In the golden

age of the empire the fair Quetzalcoatl taught the useful arts, and of the lands of Anahuac he formed a paradise. Cotton had not then to be cultivated, but grew wild, ready colored the hue of every dye. The maize plant was of such a size that a single ear was a carrier's load. Melons o'ertopped their owners' heads. Not the favored class alone, but all men possessed palaces of silver and gold. But the adversary came in the form of an old man who roused in Quetzalcoatl a desire to wander to other lands. With his departure the fruit-trees withered and the singing birds took flight. Then arose the belief that he would return, and it was the expectation of his second coming that unnerved the fierce courage of the Aztec warriors before the pale-faced Cortez. Was he the white god of their fathers? Credulity, doubt and dissension hastened their undoing.

For more than a millennium England has been a Christian nation, yet in the museum at Oxford we see images, bristling with rusty nails and needles, which demonstrate the late survival of a belief in sympathetic magic in the rural communities whence these objects came. Within the university itself I secured a desiccated specimen of a familiar vegetable which an officer of one of the colleges had carried for years as a preventive of rheumatism! Neither centuries of enlightenment nor the revolutionary changes of this progressive age have exterminated such beliefs. They even adapt themselves to the new conditions, as in the case of the lady living within the shadow of the walls of Harvard University, who maintains that carbons from arc lamps are a sure preventive of neuralgia!

I am aware that the study of these beliefs sheds light upon the history of the mental development of the race, and is of the highest value in certain theoretic considerations, but I involuntarily think of folk-lore as a study that will influence practically the life of him who engages in it. He learns that much that he has accepted from childhood without thought as truth is mere superstition and error. Not until he has had his attention called to the existence of these survivals does he realize their abundance, or the part they play in the daily lives of those around him. They are by no means confined to the servants' quarters; they are also in his own family, to whatever class or country he may belong. The nature and the prevalence of error are literally brought home to him. We all admire truth and natural law—in the abstract—and seek the widest possible knowledge of them by means of a most admirable educational system. And yet the graduate seldom possesses the power of applying theoretical knowledge to his own individual life. This is not an argument for what is termed 'a practical education,' but an explanation of a condition which I believe can be greatly improved by thorough training in anthropology.

By the comparison of customs and beliefs it was discovered several years ago that striking similarities exist whenever like environmental conditions prevail. It was the discovery of this principle of unity that led anthropologists to seek among the savages and barbarians of to-day an explanation of survivals in the Caucasian group. Hundreds of examples of these 'Ethnographic Parallels' have been observed. One will serve our purpose here. In savagery the functions of priest and physician are combined in the medicine-man. He fits himself for his profession by a rigorous training, and has the utmost faith in his own power to enlist the sympathy of the beneficent gods and to expel the evil ones. Disease he banishes with a formula of magic words, or with ceremonies that are oftentimes elaborate. Upon analysis it is found that the success of the shaman de-

pends upon two elements, the credulity of man, and the power of the sub-conscious mind. The parallel is observed in the medicine-men of that modern cult which numbers hundreds of thousands of otherwise intelligent Americans. Their healers proceed by methods no more rational than those of the aborigines, and in some respects similar to them. Their success depends upon the same two factors. The red shaman calls the headache an evil demon and proceeds to suck it through a tube. The white shaman terms it sin and dispels it by a 'demonstration.'

The student of folk-lore learns of the rise and fall of many an 'occult' belief. As this phase of human experience is intangible and variable, those only who have been instructed concerning the characteristics of thought can profit by an accumulated knowledge.

While anthropology may not be classed as a 'bread and butter' study, it does equip the student who is to become a merchant, physician, attorney, with a practical knowledge of the motives of his competitors and clients. He learns in youth the significance of the folk-saying, 'Human nature is the same the world over.' His interest in the science cannot terminate with the pass-mark of the final college examination, but must be coextensive with his interest in his kind. He will employ it in his vocation and enjoy it as an avocation.

To the aspirant for honors in the diplomatic service, anthropology offers an admirable training. He learns the significance of the racial factor in national welfare; the measure and condition of progress; the principles of ethnologic jurisprudence; and, also, the characteristics of the particular people among whom his duties lead him.

For the legislator, anthropology must become a necessary preparation. America has problems whose solution calls for the widest knowledge of races and cultures. Such knowledge, free from political bias and hereditary prejudice, can best be gained by the study of the science of man. The list of these problems is a formidable one, including Philippine slavery, Mohammedan harems, Tagal insurrections, Spanish-American complications, coolie labor, the negro problem, the Indian question, not to mention the demands for legislation that shall regulate the immigration of Poles, Russian Jews, Italians, Hungarians and others.

Anthropology prepares the law-maker and the jurist for the task of coping with crime. Criminal anthropology has explained the character and causes of criminality and degeneracy, and led to revolutionary changes in the methods of crime prevention. While it is difficult to accept all the claims of the school of which Lombroso is the accomplished master, we must acknowledge our indebtedness to it for the reforms that it has directly or indirectly inaugurated.

For the injurious effects of exclusive specialization, anthropology offers a corrective. It is particularly fatal to narrowness in the teacher, who oftentimes leads young people to specialize in his particular field before they are aware of their own aptitudes and wishes. It forearms the teacher of inferior races, who usually ignores the traditional mental activities of those he would instruct. It induces a more considerate attitude in the missionary who calls the religion of his parishioners mere superstition, and speaks with contempt of their mode of thought, not appreciating the manner of its growth through uncounted centuries of struggle.

These few representative examples but suggest the extent of the utility of the science in the affairs of men. In the training of youth anthropology furnishes a com-

prehensive outline of human knowledge, showing the relations existing among its several branches, and giving the student a correct sense of the proportion between what he knows and what there is to know. Employing the scientific method, it teaches how to observe. College training in it is continued directly in subsequent experience with the world. The material is ever at hand. Dealing with the vital problems of all epochs, it inculcates breadth of mind and develops the reason. It induces consideration and awakens appreciation of other men and other races. It supplies an available touchstone of truth and error. Wherefore it is that a new and deeper meaning now abides in the words:

"Know, then, thyself; presume not God to scan;
The proper study of mankind is man."

FRANK RUSSELL.

AMERICAN MORPHOLOGICAL SOCIETY.

II.

Notes on Cyanea Arctica: CHAS. W. HARGITT.

The early cleavage phases are passed while the eggs are still within the gonads or in the complicated folds of the manubrium. A gastrula is formed, following total cleavage, by invagination, and an early closure of the blastopore ensues. The embryo becomes ciliated before its escape from the egg membrane, within which it may be seen slowly rotating. On emergence it is almost spherical but soon assumes the ovoid shape characteristic of the Cœlenterate planula. While details as to the formation of the entoderm are not yet complete they seem in the main to confirm the observations of Hyde, Smith and the recent work of Hein.

The encystment noted by Hyde and McMurrich has been common in the specimens under consideration, though I have been able to show that the process is rather incidental than essential as claimed by McMurrich. It seems wholly conditioned upon the environment; where favorable and natural the process is rare or absent.

The scyphistoma stage of development was attained in variable periods depending again upon conditions. Under favorable conditions it may occur in from eight to ten days, while under other conditions it may not take place within as many weeks. Thus also with the changes involved in strobilization and the release of the ephyræ. Under favorable circumstances they have taken place in the aquarium within a period of eighteen days from the escape of the planula to that of the ephyra.

Stolonization occurs as in *Aurelia,* but much less freely, as does also the origin of buds from the stolons. Budding from the side of the polyp was not observed in *Cyanea,* its small size probably rendering such process difficult.

The entire life history from the egg to the free ephyra was followed in detail with unusually good results in aquaria of varying size from a mere watch glass or petrie dish to jars holding a gallon or more.

Notes on the Cœlenterate Fauna of Woods Holl: CHARLES W. HARGITT.

Inheritance of Color Among Pointers: FRANK E. LUTZ and ELIZABETH B. MEEK.

Dr. Francis Galton ('89) proposed 'briefly and with hesitation' a statistical law of heredity applicable to bisexual descent. Briefly stated, it was that one half the offspring's characteristics are derived from the parents (an equal amount from each), one fourth from the grandparents, one eighth from the great-grandparents, one sixteenth from the great-great-grandparents, and so on. Galton himself ('97) tested this hypothesis by the consideration of a single color characteristic—the conditions of being tricolor or non-tricolor—in

Basset hounds; but with this exception the important law advanced more than a dozen years ago has not, up to this time, received a careful analysis of a large number of pedigrees, of three or more generations.

Our work was carried on with data obtained from the American Kennel Club Stud Books and includes 390 dogs, of the pointer breed, of which 660 parents, 1,367 grandparents, 1,361 great-grandparents and 978 great-great-grandparents are known. Four sets of color characteristics, namely, liver or no liver, black or no black, white or no white, and 'ticked' or not 'ticked,' were considered. By the method used no substitutions were needed to fill the gaps left by unrecorded ancestors of the first four degrees. The results showed an almost perfect harmony, in each instance, between the facts and Galton's law, the greatest real deviation being only 1.1 per cent., while the least was .4 per cent.

Astrosphere and Centrosome in the Fertilization of the Egg of Phascolosoma (P. vulgare and P. Gouldii): J. H. Gerrould.

The Larval Development of Phascolosoma: J. H. Gerrould.

On the Ova of Ophidia: E. L. Mark and C. A. Crowell.

A System of Abbreviations for the Lettering of Anatomical Figures: E. L. Mark.

The Circulatory System of Lamellibranchs: G. A. Drew.

By careful injections, preparations and dissections, the vascular system of the large northern scollop, *Pecten tenuicostatus,* has been found to be extensive and definite. In the mantle, for example, the blood vessels branch repeatedly and form a very fine network that in appearance is much like a capillary plexus. From this plexus the blood is collected directly by vessels that join to form the vein that, in common with the efferent vessels from the gills of the corresponding side, returns the blood to the heart. Inasmuch as some of the coloring matter of the injecting fluid finds its way out of the vessels and into the surrounding tissue, it seems quite possible that the blood may function directly as lymph. Large lacunæ, such as are generally supposed to be present in Lamellibranchs, have not been found. The vessel that supplies the foot is capable of great distention, and offers the same for the protusion of the foot, but the vessel is very definite in shape and is not comparable to a lacuna. The course taken by the blood in its circulation is essentially the same as has been described for other forms, but the vessels seem to be much more finely branched, and the circulatory system much more nearly 'closed' than has generally been supposed to be the case with Lamellibranchs.

On the Anatomy of a Double Monster: H. L. Osborn. (Read by title only.)

A calf born near Minneapolis, Minn., in 1901, and which lived only a few minutes, came to my notice and proved interesting as a nearly complete twin formation. There is a single umbilical opening and cord, there are two functional hind legs and a single anus, but there are two tails and a third hind leg carried in the mid-dorsal line, and projecting backward. Anteriorly there are two complete animals, two heads, thoraces and two anterior abdominal regions completely developed. There is a single abdominal cavity posteriorly, but most of the viscera are double. There are two spinal columns, each sacrum articulates externally with a complete half pelvis, and these meet below, forming a symphysis, and on its opposite side each sacrum articulates with an ilium which meets a very imperfect ischium, so that here the division of the embryonic

material has not gone to a finish. The small intestines meet not far from the pylorus and communicate transversely, and a single piece continues thence to the anus, a distance of about seven feet. There is no distinction of small and large intestine, except a sudden enlargement at which two cœca are located (one for each component of the calf). There are two nearly complete circulatory systems but an umbilical artery is lacking from each side (the inner), and the internal iliac veins join and fuse in the middle line. There are two pairs of kidneys, and there are two bladders; one is in front of the other. They communicate at the fundus. The urethras are not developed; the hinder bladder has the urachus open and both bladders discharged by this passage. The ureters are symmetrically related to the two bladders; those of the outer kidneys, one from each body, discharging into the hinder bladder, while those of the two inner bladders communicate with the anterior bladder. There are two pairs of testes; the outer pair had descended, their vasa deferentia communicating with the hinder bladder, while the inner pair are still beside their kidneys and in communication with the anterior bladder.

Notes on the Trematodes of Lake Chautauqua, N. Y.: H. L. OSBORN. (Read by title only.)

Studies made in the biological laboratory of the Chautauqua College of Liberal Arts have shown that the adult stage of *Distomum (Microphallus) opacum,* Ward, is of frequent occurrence in the stomachs of the black bass, and its earlier stage in the crayfishes, where, instead of frequenting 'the space in the cephalothorax above the heart and sexual organs' (Ward, *Am. Mic. Soc. Trans.,* XV., p. 79, 1894), it is found invariably in the liver, whose effective area is frequently greatly reduced by the cysts. A second distomid occurs in the stomach of the black bass, though less frequently. It has been seen elsewhere by Wright and Linton and referred by them to *Distomum (Bundera) nodulosum.* It is not, however, identical with the European form and will very likely need to be recognized as a new species. It is characterized by a difference in the lateral lobe of the oral apparatus. Its earlier stages were found abundantly in crayfishes of the lake. They are found in nearly every crayfish examined, and occur encysted in the heart, gonads, muscle and surrounding spaces of that region. Two other species of distomids are frequent in fishes of the lake; one, an undetermined distomid of very minute size, occurs in the nearly digested slimy chyme gathered about the entrance to the small intestine, appearing like numerous minute black elongate specks scattered through the slime, and proving to be sexually mature forms, the black color due to the embryos filling the uterus. This species has not yet been located, and it seems to be not well known. Another little known and possibly new species occurs encysted in round black spots a millimeter in diameter in the skin of the fins and of the body generally, in rock bass and darters. Another distomid, unknown in the adult, was previously reported on from this locality (*Zool. Bull.,* p. 301, 1898) as occurring in *Anodonta plana* and causing the salmon-colored deposit on the inner surface of the valves of the shell. The *Anodontas* also always contain one or more individuals of *Cotylaspis* adhering to the surface of the kidney (*Zool. Bull.,* p. 85, 1898.) An extended article on these is now in course of publication. There is to be found encysted in the liver of the sunfishes a form that has not as yet been sufficiently studied to ascertain more than that it is a *Diplostomum,* or nearly related to it. Fur-

ther studies of all these forms are now being made.

The Eye of the Common Mole: James Rollin Slonaker.

The eye of the mole lies imbedded in the muscle beneath the skin, where it appears as an inconspicuous dark spot. It is situated well forward on the side of the snout.

The eye is degenerate and is no longer capable of functioning in distinct vision. The most noticeable changes which have occurred are:

1. The great reduction in the size of the eye.

2. The much crowded condition of the retina as a result of the decrease in size of the eye as a whole.

3. The noticeable reduction in the size, or the complete absence of the aqueous and vitreous chambers.

4. The varied modification of the shape and size of the lens. Also the peculiar cell structure of the lens.

All the structures of the normal mammalian eye are present in some form or other.

Two stages have been studied: (1) At birth, (2) the condition found in the adult. Very little difference is seen in these two stages excepting an increase in size.

The eye muscles and the optic nerve are easily traced back to the skull. At birth the nerve presents in its course from the eye to the skull a peculiar arrangement. The course is marked by numerous cells and few or no fibers. At the eye there is a rapid change from this cell condition to the fiber condition of the nerve tract. The fibers have not apparently grown much beyond the limits of the eye. In the adult the fibers can be traced to the skull.

The eye cleft may be seen in cross sections. It is very small and of practically the same diameter in both horizontal and vertical sections through it. It meets the eye at such an angle that it is impossible for rays of light, should any enter, to pass through the eye along the axis of vision.

All the elements of the normal retina are present, but, owing to the much crowded condition, the ganglion cell layer is much increased in thickness.

The lens, which is found in a great variety of shapes and sizes, is composed of peculiar cartilage-like cells with well-defined nuclei. It is therefore incapable of functioning as a normal lens.

It is very doubtful therefore whether the eye of the mole functions in any sense. At the best it can do no more than distinguish between light and darkness.

The Breeding Habits of Certain Fishes: Jacob Reighard.

1. Experimental evidence was offered that the nests of *Amia* are built by the male fish alone. Access to an area of the natural breeding ground was barred by a fyke net, in which fish that attempted to reach the breeding ground were caught and kept living. The males were removed from the net and placed in the natural enclosure behind it; the females were confined in a crate. Twenty-three nests were built by the males and of these only five ever contained eggs. These eggs were apparently all laid by one or two females that had gained access to the enclosure. The remaining eighteen nests were never used and were finally abandoned.

2. It was pointed out that the colors of the male *Amia* are protective in the breeding season. The fins are all colored green in harmony with the surrounding vegetation. The reticulation of the sides is in close imitation of the shadows cast by the interlaced and floating parts of water plants. The tail spot is strikingly like certain refraction images cast on the bottom

by irregularities of the surface of the water. Such images are small black spots, orange or yellow bordered.

3. It was pointed out that in the male of *Eupomotis gibbosus* the colors are much brighter than in the female. The vermicular markings on the cheeks of the male are more brilliant than those of the female; the opercular ear-flap is larger and bordered with scarlet and blue; the ventrals of the male are black, while those of the female are yellow; the dorsal and caudal of the male are much more brilliantly blue than those of the female. In approaching the female, in order to induce her to enter his nest to spawn, the male elevates or puffs out the gill covers so as to display their brilliant markings. At the same time the opercular ear-flaps are erected and the black ventral fins spread out. When in this attitude the male faces the female and it is when seen from the front that his display of color is most brilliant. He assumes a similar attitude when threatening other males. He was never seen to assume this attitude except under the circumstances described, so that the display of color resulting from the attitude must be regarded as a means of expressing the emotions.

The Early History of the Lateral Line and Auditory Anlages in Amia: CORA J. BECKWITH. Presented by Jacob Reighard.

No common anlage of the auditory pit and lateral line system, such as has been described in Teleosts by Wilson, was found in *Amia*. The auditory pit was found to arise much earlier than the lateral line system and in the usual way. It is at first imbedded in an elongated mass of mesectoblast proliferated from the neural crest. This mass of mesectoblast, with enclosed auditory pit, bears a considerable resemblance to the common anlage of auditory pit and lateral line system referred to above. It subsequently extends into the adjacent gill arches, where its further history was not followed. The lateral line system makes its appearance at a later stage in the form of several independent ridge-like thickenings of the ectoblast which subsequently fuse. It is at no time connected with the anlage of the auditory pit.

The Vascular System of the Common Squid, Loligo pealii: L. W. WILLIAMS.

The knowledge of the histology of the vascular system of decapod mollusks is very incomplete, especially in reference to the extent of the capillary system. In addition to the capillaries, lacunæ have been believed to intervene between the arteries and veins. The extent of the capillary system was determined by injecting the vascular system with Berlin blue, and the lining of the vessels was studied by means of silver impregnations. Both the arterial and branchial hearts seem to lack an endothelium. The branchial heart consists of striated muscle and apparently secretory polygonal cells. The intrinsic muscle of the peristaltically contractile arteries resembles connective tissue. The arteries and veins are connected in all parts of the squid by capillaries. All the vessels are lined by an endothelium. The veins are connected with small end-sinuses which enclose the terminal branches of the arterioles and receive numerous capillaries, some of which arise from the perforating arteriole. The so-called lacunæ which partially enclose the pharynx and eyes are sinuses, since they have endothelial walls and since they intervene between veins, not between veins and arteries.

The wide distribution of the capillary vessels, the presence of an endothelium around every blood-containing cavity except possibly the heart, and the absence

of demonstrable lacunæ, all lead to the conclusion that the arterial and venous vessels of the squid are connected by capillaries which form a closed vascular system.

The Branchial Nerves of Amblystoma: G. E. Coghill.

1. There is, in larval *Amblystoma*, a complete series of pre-trematic rami of the ninth and tenth nerves. These rami are distributed wholly to the epithelium of the branchial arches and are therefore comparable to the pre-trematic nerves of fishes. Drüner finds the same series of nerves in *Triton* and *Salamandra*, and the first two of the series in *Proteus* and *Menobranchus*.

As in some fishes, there is an anastomosis in *Amblystoma* between the ramus post-trematicus IX. and the first ramus pre-trematicus X. In some individuals there is a similar anastomosis in the second and third branchial arches and in the hyoid arch between the facial and glossopharyngeus. The latter has been found by Drüner in *Triton*.

2. The ramus alveolaris VII. of *Amblystoma* is a pre-spiracular nerve and, as such, cannot be homologous to the ramus mandibularis internus of *Anura*. These two nerves innervate homologous areas and terminate in homologous centers in the brain. They differ, however, in the following important features: (*a*) The ramus alveolaris passes anteriorly of the derivative of the spiracular cleft, while the mandibularis internus passes caudally of that structure; (*b*) the alveolaris passes dorsally of the mylohyoid muscle, while the mandibularis internus passes ventrally of that muscle; (*c*) the alveolaris anastomoses with the trigeminus while the mandibularis does not.

These differences may be explained by reference to *Squalus acanthius*, in which both nerves are present. Here the areas innervated by the two nerves in part coincide and the terminal fibers of the two anastomose. Obliteration of a pre-spiracular nerve of the selachian type in *Anura*, and of a like post-spiracular nerve in *Amblystoma*, would give the two divergent amphibian types of distribution of the facialis.

The Anatomy of the Drumming Organ in some Marine Fishes: A. K. Krause.

The Cell-Lineage of the Mesoblast-Bands and Mesenchyme in Thalassema: John Cutler Torrey. (Read by title only.)

As in many other annelids and mollusks the middle germ-layer has, in *Thalassema*, a double origin. The mesoblast-bands (entomesoblast or cœlomesoblast) arise in the typical manner from D.4, the posterior member of the fourth quartet, which also contributes two small, but not rudimentary, cells to the posterior part of the gut. The 'larval mesenchyme' (ectomesoblast or pædomesoblast) arises, as in most other forms, from cells of the earlier or ectoblastic quartets; but whereas in the forms hitherto described it arises from only one quartet and only in certain quadrants, in *Thalassema* it arises from all of the three quartets and in all of the quadrants (though this latter statement does not apply to all of the quartets). At least twenty primary ectomesoblast cells are formed; but of these only ten are functional, while at least ten are rudimentary and disappear without becoming functional. Of the functional mesenchyme-cells, three are derived from the third quartet and seven from the first. These give rise not only to the larval muscles, but also in part to those of the adult. Of the rudimentary cells, six arise from the first quartet and one from each quadrant of the second quartet. These cells pass into the interior of the entoblast cells, are absorbed, and wholly disappear. They are

probably to be regarded as vestigial cells which have been supplanted by other mesenchyme cells.

A Case of Compensatory Regeneration in Hydroides dianthus: C. ZELENY. (Read by title only.)

Primary Hexamerism in the Rugosa (Tetracoralla): J. E. DUERDEN. (Read by title only.)

Numerous serial sections of the rugose coral, *Lophophyllum proliferum* (McChesney), prepared for the author by the United States National Museum, enable him to confirm the observation of Pourtalès in 1871 that six primary septa occur at the tip of the corallum. Duncan and Kunth have independently found the Palæozoic *Heterophyllia*, and Frech the Devonian *Decaphyllum*, likewise to be primarily hexameral, while apparently no sections of any rugose types have been described revealing only the four primary septa which are usually assumed to be characteristic of the Tetracoralla. There is good reason for concluding that the Palæozoic corals were primarily hexameral, as is the case with modern corals and actinians (Ceriantheæ excepted).

The serial sections of *Lophophyllum* beyond the tip permit of the order of appearance of the later septa being established. These are found to arise in bilateral pairs within four of the primary interseptal chambers in conformity with Kunth's law. Instituting a comparison of this method of septal increase with what is known of the mesenterial and septal succession in modern Zoantharia, it is shown that the rugose corals are very closely related to the living Zoanthid polyps. In the latter new mesenteries appear at one region within only two primary exocœlic chambers, while in the Rugosa they must have appeared in the same manner within four primary chambers and rarely within six. The Zoanthids probably bore much the same relationship to the corals of Palæozoic times which the actinians of today bear to recent corals.

The Course of the Blood Flow in Lumbricus: SARAH WAUGH JOHNSON. (Reported by J. B. Johnston.)

The course of the blood flow in *Lumbricus terrestris* was studied by watching the pulsations, cutting the vessels, holding with forceps, and by various combined and indirect experiments. The main result is to show that the circulation in *Lumbricus* is not fundamentally a segmental one, upon which a partial systemic circulation has been superimposed, but is wholly systemic. The blood flows forward in the dorsal vessel to the extreme anterior end of the worm, downward in the hearts, and in both directions from the hearts in the ventral vessel. The flow is backward in the subneural vessel and upward from the subneural to the dorsal in the parietals. From the ventral vessel the blood goes to the intestine, body wall, and nephridia. From these organs it is gathered up by the dorso-intestinals, branches of the subneural, and parietals, and emptied into the dorsal. Thus the blood is carried backward by the longitudinal trunks on the ventral side of the body, upward through the body wall, intestine, nephridia, etc., to the dorsal, and forward in the dorsal to the hearts. Since the flow is upward in all the circular vessels, no complete circuit within a single segment is possible for any part of the blood. In the anterior end of the worm blood is carried forward by both the dorsal and ventral vessels, and backward by the subneural and lateral vessels. The latter have connections in several segments with the subneural, anastomose with the parietals of segments XII. and XIII., receive blood from the body wall, nephridia, and seminal vesicles, and empty

into the dorsal vessel in segment X. and, by way of the parietals, in segments XII. and XIII. This system is to be considered as representing the parietal vessels of the region in front of the last pair of hearts.

A Contribution to the Arterial System in Cryptobranchus: H. H. Keener.

Presented by J. B. Johnston. (Read by title only.)

The Larva of Naushonia crangonoides: Millett T. Thompson.

It was my good fortune, while at Woods Holl last summer, to identify and rear the larvæ of *Naushonia crangonoides* (Kingsley), a small Thalassinid Crustacean taken near Wood's Holl in 1893.

Three zoëa and two mysis stages are recognizable, during which stages the metamorphosis is inconsiderable, the 'habitus' being similar in all. The mysis phase, however, closes with a sharp change, the adolescent phase resembling the adult more closely than is usual among the Crustacea. The zoëa and mysis phases of this species are distinguished from all other known Crustacean larvæ—with two exceptions—by their peculiar form. The carapax is elongated behind the eyes into a 'neck'; the rostrum is short and arcuate; the body is without spines, though the anterior abdominal segments bear hook-shaped processes at their posterior angles; the sixth segment of the abdomen is very elongate. The mandibles are remarkably asymmetrical, although symmetrical in the adolescent stages and hence probably in the adult.

Two other larvæ resemble these in form; a larva of unknown parentage from the English coast, in regard to whose mandibles data are lacking; and the well-known larva of *Calliaxis adriatica* (Heller). The mandibles of the latter are like those of the *Naushonia* larva in shape, and similarly the one on the left is hook-shaped and the one on the right conical. Leaving out of the question the too little known English form, we find that the likeness between the larvæ of *Naushonia* and those of *Calliaxis* is not due to convergence, but to a close relationship existing between the species. This is easily demonstrable by comparing the adults of the two species.

Calliaxis and *Naushonia* do not seem to be very closely related to the other species grouped in the Thalassinidea, excepting possibly *Laomedia* (DeHaan). They perhaps represent a group which has approached the Thalassinidea in some respects, but whose descent must be sought along a different line from that of the other genera of this group.

On the Spinal Homologues of the Cranial Nerve Components: J. Playfair McMurrich.

The researches of Strong and C. J. Herrick have demonstrated the existence in the cranial nerves of five distinct components which may be termed the lateral line, somatic sensory, viscero-sensory, median motor and lateral motor components. The first of these are undoubtedly confined to the cranial region, but of the other four it seems probable that homologues exist in the spinal nerves. The somatic sensory components, being supplied to the skin, are naturally to be homologized with the components of the dorsal spinal roots which have a similar distribution, and the equivalents of the viscero-sensory fibers, distributed to the endodermal sense-organs and epithelium, are to be looked for in those sensory fibers from the posterior root ganglia which accompany the efferent fibers of the sympathetic system to the viscera.

As regards the two motor components, the homologues are not so apparent. The observations of van Wijhe have shown that the cranial muscles belong to two categories, the musculature of the branchial

arches being derived from the ventral mesoderm and the remaining cranial musculature from the dorsal mesoderm. It is noteworthy that the branchial musculature is supplied by lateral motor nerves and by these alone, while the dorsal musculature is supplied by median motor roots. Consequently the nerves supplied to the myotomic muscles of the trunk are to be regarded as the homologues of the cranial median motor nerves, while the white rami fibers, which control through sympathetic neurons the visceral musculature of the trunk derived from the ventral mesoderm, are the equivalents of the cranial lateral motor components.

The other ideas referred to in the paper may, for lack of space, be stated summarily. (1) The distinction between voluntary and involuntary muscles is a physiological and histological one, and not morphological, and the branchial musculature is morphologically equivalent to the visceral musculature of the trunk. (2) The branchiomeric segmentation is not identical with the myotomic, but in the cranial region there exist together two distinct segmentations. (3) Of these the branchiomeric segmentation is probably the older phylogenetically.

Geographical Distribution of Fresh Water Fishes of Mexico: S. E. MEEK. (Read by title only.)

Feeding Habits of a Spatangoid, Mæra atropos; a Brittle-Star Fish, Ophiophragma Wurdmannii, and a Holothurian, Thyone briareus: CASWELL GRAVE.

The observations here given were made on animals kept in the Beaufort U. S. F. C. Laboratory in aquaria in which a balance had been established between animal and plant life by means of diatoms. The spatangoids were reared from plutei.

The function of the so-called ambulacral brushes of spatangoids, which are so conspicuously waved about in the water above the animals when dug up and placed in aquaria, has been thought to be principally a respiratory one, but I have found that the animals use these brushes as hands for grasping bunches of sand and diatoms and carrying them to the mouth, the bristles of the brush being used as fingers.

Ophiophragma lives below the surface of the sand, with the oral surface of its disc and arms applied to some large object and with the tips of its arms extending into the water above. The foot-tentacles, distributed in pairs along each arm, are seen to be in constant waving motion, and by close observation it may be seen that they are busily engaged in passing little pellets of sand and diatoms toward and into the mouth. Down the oral surface of each arm is travelling a procession of pellets which have been gathered up by the more terminal tentacles and which are being successively handed on by the more proximal pairs.

Thyone, in feeding, fully extends the long branching tentacles which surround its mouth, and mops them about in the sand until they are well covered with sand grains and diatoms; then they are, one by one, turned back and poked down the throat; the mouth closes around the base of the tentacle and, when withdrawn, it is free from all débris.

A Method of Rearing Marine Larvæ: CASWELL GRAVE.

A method of rearing echinoderm larvæ which I have used for two seasons with much success consists in supplying the aquaria containing them with a generous amount of sand containing diatoms.

From twelve to twenty-four hours after fertilization, the eggs reach a stage in which they swarm at the surface of the water. At this time it is easy to get a pure culture of larvæ by skimming the

surface of the dish in which the eggs were fertilized. The larvæ thus collected are placed in an aquarium of fresh sea water. At the same time there are also added a dozen or more pipettefls of the *surface* sand from an aquarium containing a culture of diatoms. (Prepared by putting a liter or more of sand, dredged from the ocean bottom, in an aquarium of sea water and allowing to stand several days.) The jar thus stocked is now covered and set before a window, where it is well, but indirectly, lighted.

The diatoms keep the water *pure* and furnish an abundant supply of the *natural food* of the larvæ, and, because of the balance established in the aquarium between animal and vegetable life, the supply of *oxygen* is kept constant and there is no need for frequent changes of water. The larvæ are thus protected from the destructive effects of *rapid changes in temperature* produced when fresh ocean water is added to that which has stood in the house.

A number of spatangoids and sand-dollars, which had just completed their metamorphosis on September 22, have been kept in a healthy and growing condition to the present time (January 1) in such a diatom-stocked aquarium holding one liter. The water has been changed twice during the three months in order to replace the salts used by the diatoms and echinoderms.

Abnormalities in Development of Hybrid Fishes: W. J. Monkhaus. (Read by title only.)

On the Genera of the Hydracarini: Robt. H. Wolcott.

However much we may pride ourselves on the naturalness of our present classification, it nevertheless must be admitted that it is a purely artificial device. Thus it seems legitimate to make use of every modification, however artificial it may be, which increases its serviceability without at the same time doing violence to any of our accepted ideas concerning phylogenetic relationships. In the characterization of various groups, of higher or lower rank, authors have made use frequently of characters so dissimilar as to make it difficult to compare the descriptions or to reduce them to such form as to make them serviceable in a general treatment of the subject. If, in any group, characters can be found which are of family value, others which are generic, and still others clearly specific, while all other variations can be recognized as within the limits of specific variation, systematic work in the group will be greatly facilitated by the recognition of the fact and a clear definition of the value of each factor. It is evident that for each collection of forms that may be treated together in this manner, however many may be thus included, characters will be found which are peculiar to those forms and other characters must be found for any other similar collection. It is also evident that any character which would otherwise be of a given value may, if greatly developed, have its value so increased as to become a character of the rank next above, especially if accompanied by other characters of the higher rank. If this development stand alone it is better to consider it in the line of aberrancy within the lower group. It is further desirable, as soon as these characters may be determined upon for any group, that for the subdivisions of that group diagnoses be formulated which shall bring these characters sharply into contrast; and in the interest of accuracy it is desirable that each of these diagnoses should contain in the briefest possible form a statement concerning all the characters belonging to a subdivision of that rank. Furthermore, for each group a type should be selected in accordance with

the recognized rules of priority. When for any group such diagnoses of the different subdivisions shall have been published, and, after discussion, so modified as to be acceptable to the majority of students of the group, forms subsequently described should be accompanied by similar diagnoses and similar designations of a type which will render them strictly comparable to forms already known.

The Hydracarini form a sharply limited and very homogeneous group in which the application of such a scheme as proposed above seems practicable. Accordingly, it is suggested here, and in the complete paper it is expected that there will be given for each family and genus: first, the name having priority; second the author of the same, together with the date and exact reference; third, a diagnosis in Latin and English; fourth, the type, with reference to the author and exact date, together with the reasons for selection of the same.

Southeastern United States as a Center of Geographical Distribution of Fauna and Flora: CHARLES C. ADAMS. (Read by title only.)

In general the geographical relationship of the fauna and flora of the northern United States, east of the Great Plains, is with that of the Southeast, and points to an origin in that direction, except in the case of the distinctly boreal forms. The abundance and diversity of life in the Southeast indicate that it has been, and now is, a center of dispersal. The relicts indicate that it has been a center of preservation of ancient types, and the endemism shows that it has been a center of origin of types. There are two distinct southern centers of dispersal in temperate United States, one in the moist Southeast and the other in the arid Southwest. Nine criteria, aside from fossil evidence, are recognized for determining the center of origin or the locality of dispersal: (1) Location of the greatest differentiation of a type; (2) location of dominance or great abundance of individuals; (3) location of synthetic or closely related forms; (4) location of maximum size of individuals; (5) location of greatest productiveness and its stability, in crops; (6) continuity and convergence of lines of dispersal; (7) location of least dependence upon a restricted habitat; (8) continuity and directness of individual variations or modifications radiating from the center of origin along the highways of dispersal; (9) direction indicated by biogeographical affinities and (10) annual migration routes in birds. There are three primary outlets of dispersal from the Southeast: (1) The Mississippi Valley and its tributaries; (2) the Coastal Plain, and (3) the Appalachian Mountains and adjacent plateaus. The first two have also functioned for tropical types and the third for boreal forms. Dispersal is both forward and backward along these highways. It is desirable to study individual variation of animals and plants along their lines of dispersal and divergence from the center of origin, in such characters as size, productiveness, continuity of variation, color variation, and changes of habit and habitats. Life areas should be studied as centers of dispersal and origin and hence dynamically and genetically.

Description of Cephalogonimus vesicaudus, sp. nov.: W. S. NICKERSON. (Read by title only.)

Fresh Water Polychæta: H. P. JOHNSON.

The Lateral Line System of Polyodon spathula: HENRY F. NACHTRIEB.

The paper considered only the general anatomical features of the lateral line of *Polyodon*. In general the systems of the

two sides are symmetrical, but in the position, distribution, number and minor details of the branches from the 'lateral' and 'main' canals there is considerable variation. In none of the several hundred specimens examined were these branches grouped as described and figured by Collinge. In all cases they were found all along the 'lateral' canal, the great majority being ventral to the canal. As a rule, one to three at the anterior end of each system begin on the ventral side of the canal and, after running a short distance in that direction, turn dorsalward and terminate in the usual branchlets and clusters of sense organs on the dorsal side of the canal.

The points made were demonstrated with dried skins of the fish upon which the systems had been painted over with white paint, and photographs of similarly prepared skins.

Conditions of Fossilization: J. Culver Hartzell. (Read by title only.)

Professor Hartzell's paper was a review of a series of investigations he has been making, the objective point of which is to find the laws (?) governing the conditions of fossilization for the various classes of Invertebrates in the same and in different formations.

Before the laws desired can be formulated, it is necessary (*a*) to know the mineral composition of the skeletal parts of living invertebrates; (*b*) to know the condition of the fossil, *i. e.*, whether it be the original, a mold or a cast; (*c*) to know the mineral composition of the fossil; (*d*) to know what mineral change has taken place during fossilization where the cast is one by molecular replacement; (*e*) to know the lithological composition of the formations in which fossils occur; (*f*) to know the relationship between the fossil and the formation.

The conversion of an organism into a fossil depends upon the character of its skeletal parts, the material in which it is buried and the material brought in in solution by infiltration. The material of which the skeletal parts is composed varies in different groups, being more durable in some than in others and therefore plays an important part in the preservation of the organism. The variation in the lithological character of the material in which the organism is buried also plays an important part. Certain organisms are preserved as originals, others as molds and casts, in the same formation, and locality. In this same formation, but in a locality of different lithological character, those groups which were lost under the former condition may be retained under the latter, and *vice versa.*

So far, twenty-five horizons and forty-four localities in the United States, Canada, England and Germany have been examined with special reference to the lithological character of each formation at the various localities and the conditions of preservation of the fossils. Tables have been prepared giving the general mineral character of the skeletal parts of living invertebrates, minerals replacing original minerals secreted by the organisms, and a comparative table showing the mineral composition of living and fossil invertebrates.

The paper was illustrated by means of photographs, drawings and models.

Origin and Migration of the Germ-Cells in Squalus Acanthias: Frederick Adams Woods.

The germ-cells in this form are not derived from the germinal epithelium of the body cavity, as is commonly taught, but are traceable before the mesoderm has split to form the cœlom, and in a region that may be called extra-embryonic.

In the earliest stages in which they can be distinguished from body cells they all lie in two little round groups under the blastodermic rim in the posterior part of the embryo, and just at the junction of the three germ layers as well as in the endoderm itself.

During the growth of the embryo these clusters move inward from each side towards the median line. (Embryo of 3 mm.)

The cells then become separated from each other and are scattered in the unsplit mesoderm, though none are yet to be found in the segmented portion of the middle germ layer.

When the mesoderm splits, nearly all succeed in getting on the median or splanchnic side of the body cavity which is then formed.

From this time up to the period of sexual differentiation (embryo of 28 mm.) these cells migrate relatively to the other tissues so that they progressively lie just beneath, at the side of and then dorsalward to the intestinal tract. They then make their way through the mesentery in which most of the cells are found (embryos of about 11 mm.), and finally reach their destination in the epithelium of the genital gland.

During no part of this process are germ-cells ever derived from mesoderm cells, nor do they ever go into the formation of any part of the body.

They retain their yolk and other characteristics of the cells of the early blastoderm stage and it is the body-cells, not the germ-cells, that are differentiated.

Thus the hypothesis of Naussbaum that 'sex cells do not come from any cells that have given up their embryonic character or gone into building any part of the body, nor do sexual cells ever go into body formation,' finds a confirmation in facts.

Histological Changes in the Regeneration following Normal Fission of Planaria maculata: W. C. CURTIS. (Read by title only.)

Variation in the Hepatic Ducts of the Cat: R. H. JOHNSON. (Read by title only.)

An Electric Lamp for Microscope Illumination: MAYNARD M. METCALF. (By title.) Will be published in full in SCIENCE.

M. M. METCALF,
Secretary.

AMERICAN PHILOSOPHICAL ASSOCIATION.

THE American Philosophical Association held its first meeting at Columbia University, New York, on Monday and Tuesday, March 31 and April 1, 1902. The Association may be regarded as a daughter of the American Psychological Association, to which fully three fourths of its nearly one hundred charter members also belong. For several years past the Psychological Association has provided for the reading of papers in general philosophy at its meetings by philosophical sections. This arrangement generously met a practical demand, but the relation was anomalous. The desire for more adequate recognition of the philosophical interests was met by the organization of the new Association at a conference held last November in New York. Professor J. E. Creighton (Cornell), editor of the *Philosophical Review*, was chosen president, Professor A. T. Ormond (Princeton), vice-president, Professor H. N. Gardiner (Smith), secretary-treasurer, and these, together with Professors Armstrong (Wesleyan), Duncan (Yale), Everett (Brown) and Hibben (Princeton), were constituted an executive committee to invite others to membership, to draw up a constitution and to arrange for the first meeting. The constitution adopted at the recent meeting defines the

object of the Association as 'the promotion of the interests of philosophy in all its branches, and more particularly the encouragement of original work among its members.' The relation of the Association to the previously established Western Philosophical Association was referred to the executive committee to report at the next meeting. The next meeting will be held in Convocation Week in Washington in affiliation with the other societies, part of the time, probably, in joint session with the Psychological Association. The officers for the ensuing year are president, Professor A. T. Ormond (Princeton), vice-president, Professor, A. Meiklejohn (Brown), secretary-treasurer, Professor H. N. Gardiner (Smith), and the other members of the executive committee, Professors A. C. Armstrong (Wesleyan), J. G. Hibben (Princeton), W. Caldwell (Northwestern) and D. Irons (Bryn Mawr). The following is the list of papers read at the recent meeting:

Monday, March 31.

10 A.M.

'Poetry and Philosophy': Dr. Ralph Barton Perry.

'Recent Criticism of the Philosophy of T. H. Green': Professor William Caldwell.

'The Æsthetic Element in Human Nature': Professor E. Hershey Sneath.

2 P.M.

'Address of Welcome': President Nicholas Murray Butler.

'The Functional Theory of the Distinction between the Psychical and Physical': Professor H. Heath Bawden.

'The Atomic Self': Professor George Stuart Fullerton.

8 P.M.

Address of the President. Subject, 'The Purposes of a Philosophical Association': Professor James Edwin Creighton.

Discussion on the Address: President Francis L. Patton.

Tuesday, April 1.

10 A.M.

'The Concept of the Negative': Dr. W. H. Sheldon.

'Being, Not-Being and Becoming: a Study in the Logic of Early Greek Philosophy': Professor Alfred H. Lloyd.

'Aristotle's Theory of Reason': Professor William A. Hammond.

'On Final Causes': Dr. Edgar A. Singer, Jr.

'On the Study of Individuality': Professor J. A. Leighton.

2 P.M.

'The Consciousness of Obligation': Professor E. B. McGilvary.

'Kant and Teleological Ethics': Professor Frank Thilly.

'Epistemology and Ethical Method': Dr. Albert Lefevre.

'The Epistemological Argument for Theism': Professor Edward H. Griffin.

'The Philosophy of Religion: Its Aim and Scope': Dr. F. C. French. (Read by title.)

A pleasant feature of the meeting was the reception given to the members, about forty of whom were in attendance, by President and Mrs. Butler in the Avery Library on Monday evening. The thanks of the Association are also due to President Butler and the officers of the University for the admirable accommodations in Earl Hall.

H. N. Gardiner,
Secretary.

SCIENTIFIC BOOKS.

Inorganic Evolution as Studied by Spectrum Analysis. By Sir Norman Lockyer, K.C.B., etc. London, Macmillan and Co. 1900. Pp. vi + 198; 44 figs.

The author states in his preface that this 'volume contains an account of my most recent inquiries into the chemistry of the stars, and of some of the questions which have grown out of these inquiries.' Dissociation is the main topic of the book, and the author makes the 'endeavor to show how, in the studies concerning dissociation, we have really been collecting facts concerning the evolution of the chemical elements,' and he points out 'especially that the first steps in this evolution may possibly be best studied by, and most clearly

represented in, the long chain of facts now at our disposal touching the spectral changes observed in the hottest stars.'

The separate 'books' into which the small volume is divided are entitled as follows: I., 'The Basis of the Inquiry'; II., 'Application of the Inquiry to the Sun and Stars'; III., 'The Dissociation Hypothesis'; IV., 'Objections to the Dissociation Hypothesis'; V., 'Inorganic Evolution.' The work therefore deals with a chemical problem by the methods and with the results of astronomy. It does not primarily treat of the theory of stellar evolution, which is now being gradually built up on the foundation of the new facts of astronomy and astrophysics. The author presents his evidence in his usual brilliant manner, and it is easy to see how one may be carried along to his conclusions, if the evidence is not carefully examined. The dissociation hypothesis is undoubtedly a particularly alluring one to the astronomer, as presenting a comparatively easy escape from some of the difficulties of solar and stellar physics. But the validity of the evidence upon which any such theory is based should be beyond question, and this cannot be said of some of the evidence here presented. It is also very doubtful if other workers in these lines can share Sir Norman's optimistic view expressed on page 29: "I propose to pass over the history of nearly twenty years' work, with all its attendant doubts and difficulties, and deal with what that work has brought us, a perfect harmony between laboratory, solar and stellar phenomena." To many it may appear that the discoveries of facts in spectroscopy in recent years have tended to temporarily diminish rather than increase the harmony between the phenomena observed in the laboratory and the heavens.

The reviewer's copy of the book contains many marginal queries as to the correctness of the evidence brought forward as representing the facts. Thus, for instance, we read on page 34 of "the simplification of the spectrum of a substance at the temperature of the chromosphere. To take an example, in the visible region of the spectrum, iron is represented by nearly a thousand Fraunhofer lines; in the chromosphere it has only two representatives." Now recent photographs of eclipse spectra—and first of these that obtained in 1896 by Sir Norman's assistant, Mr. Shackleton—actually show the presence of a great number of iron lines at the base of the chromosphere, matching almost every one of the strong dark lines ascribed to iron in the solar spectrum. In several places the assertion is made that the lower chromosphere is certainly not the origin of the Fraunhofer lines, although the author's own photographs of the 'flash spectrum' at the Indian eclipse of 1898 clearly contradict this.

We are surely much indebted to Sir Norman for his valuable researches on the lines having greater intensity in the spark than in the arc spectrum, to which he has applied the term 'enhanced lines.' But it is difficult to avoid the impression that he attaches an exaggerated importance to their significance in solar and stellar spectra. To the vapors producing the enhanced lines he prefixes 'proto,' as proto-magnesium, proto-iron, suggesting that at high spark temperatures a finer form of the element is developed. The spectrum of α Cygni is considered to contain chiefly the enhanced lines; numerically, 120 enhanced metallic lines were found in approximate coincidence with some of the 307 lines measured in the spectrum of α Cygni; or, dealing only with the strongest lines, 'the coincidences with enhanced metallic lines with the dispersion employed amount to 38' out of 40. The reviewer has not been able to fully confirm this resemblance on comparing the wave-lengths found in α Cygni by other observers with Sir Norman's lists of enhanced lines of metallic spectra, and had hoped to make the comparison on recent plates taken at the Yerkes Observatory; but this would have too long deferred this review. However, one of the points especially emphasized by Sir Norman is the superior temperature of the reversing layer of α Cygni to that of the sun. As his reasoning is based on the incorrect premise that the reversing layer lies outside the chromosphere, the conclusions are not convincing. On this and similar evidence is constructed the author's elaborate and ingenious classification of stars into genera depending upon their density and temperature, divided into ascending and descend-

ing branches. The reviewer must confess his inability to understand clearly Professor Lockyer's differentiation between descending and ascending stars, although not wishing to question the probability that both branches exist.

In subsequent chapters the author interestingly discusses the bearing upon the dissociation hypothesis of the recent discoveries of series in the spectra of the elements, of pressure shifts of lines, of magnetic perturbations (Zeeman effects), and of the 'fractionation' evidence. He finds in them a quite satisfactory confirmation of his hypothesis, and displays great skill and command of the subject in marshaling to its support the data from such various sources.

As has been said of other volumes in this series, the illustrations do not adequately reproduce the author's original photographs, and could be greatly improved upon in a future edition.

EDWIN B. FROST.

Outlines of Electrochemistry. By HARRY C. JONES, Associate Professor of Physical Chemistry in the Johns Hopkins University. New York, The Electrical Review Publishing Co. Price, $1.50.

The author has not tried to give an exhaustive account of electrochemistry, for he prepared the seven chapters, which cover about one hundred pages, for a technical journal, whose readers are for the most part men busy in every field of applied engineering science; consequently he wisely selected those theoretical topics which would appeal most strongly to this particular class of students. The book, however, will prove instructive and helpful to all who wish to get a clear and definite knowledge of the subjects it presents. The writer has read it with profit, and feels sure that he does not err in recommending it. One might, however, well ask whether 'the whole subject of the electrolytic separation of the metals was opened up' (p. 44) through the study of the decomposition values of the ions by LeBlanc, Freudenberg and others in Ostwald's laboratory, when it is recalled that all but three or four of the separations recorded by these chemists had been made long before by others? Or, if 'the decomposition values of the ions' is the vital point, should we omit mention of the work of Kiliani, who first carried out metal separations by attention to the differences in electromotive force? Perhaps these may be regarded as minor matters, but the historical development of the subject calls for their presence.

EDGAR F. SMITH.

Enzymes and Their Application. By Dr. JEAN EFFRONT. Vol. I., The Enzymes of the Carbohydrates. Translated by SAMUEL C. PRESCOTT. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1902. 8vo. Pp. 322.

This is a very excellent work and is a valuable addition to the literature on enzymes and their application. The book is designed to meet the wants of not only scientific investigators, but also of those interested in the industrial application of these substances, and will be appreciated by both classes. The author has carried out his purpose in a clear, concise manner. From the standpoint of theoretical consideration he is careful and conservative, and his treatment of the technical application of enzymes to commercial practices is unusually full and clear for a work of this kind. The book is more than a compilation, inasmuch as the author has, as stated in the preface and borne out by internal evidence, confirmed in his laboratory most of the facts presented. The second volume which is now in course of preparation, will take up the proteolytic enzymes and the toxins, and its appearance will be looked for with interest. Professor Prescott is to be congratulated in presenting a translation that in no way detracts from the original. The printing is well done and the paper and binding good.

ALBERT F. WOODS.

BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

Animals of the Past. By FREDERIC A. LUCAS. New York, McClure, Phillips & Co. 1901.

One who has had much to do with a public museum of extinct vertebrates is pretty sure of the queries that the ordinary sight-seer will

propose for answer. Meaningless bones will be clothed with new interest when it is learned that they are millions of years old, and that the place whence they came was once the bottom of an ocean or broad lake. And he invariably desires to learn how it is known where to dig for them, how they are preserved, and a multitude of similar things. It is very evident that the author of 'Animals of the Past' has had no inconsiderable experience in answering such questions, else he could hardly have encompassed within its pages so much and so clear information about those things that the general public desires most to know concerning fossils. We will not quarrel with him for the omission of a limiting adjective in the title, nor suggest that some of its humor is a trifle far-fetched, in consideration of the fact that the book on the whole is very good. One who is acquainted with the author's work in paleontology will expect accuracy and reliability, and he will not be deceived here. He has kept his imagination in check—not always an easy thing for the paleontologist to do!—and has said what he has to say in an easy way that even the schoolboy will enjoy. The book is, moreover, scientific, and not a collection of paleontological fables; it is, I think, the best of its kind yet published. It tells how the bones of extinct animals become fossilized, are found, collected, restored and mounted, of the many problems they present and the inferences they suggest, the causes of growth and decay among the animals of the past, etc.; matters that really interest the general reader quite as much as details concerning creatures which he can only imperfectly comprehend. But the contents would belie the title, were this all. Many of the largest, most interesting and remarkable of extinct backboned animals, the rulers of the air and sea and dry land, mastodons, mammoths, horses and the like are described, and illustrated by restorations as in life from the skilful brush of Gleeson and Knight. Knight's reputation in such things is well known—his work is the very best, but Gleeson in the present instance comes a close second to him. The book is a good one for both the public and private library.

S. W. WILLISTON.

SCIENTIFIC JOURNALS AND ARTICLES.

The Osprey for February contains 'Notes on the Habits of the Broad-winged Hawk (*Buteo platypterus*) in the Vicinity of Washington, D. C.,' by J. H. Riley; 'Rambles about my Old Home,' by Milton S. Ray; 'The Mocking Bird at Home,' by F. H. Knowlton; 'Reminiscent, Random and Maine Bird Notes,' by W. C. Kendall, and a sketch, with portrait, of that most able ornithologist, 'Professor Alfred Newton,' by R. W. Shufeldt. The supplement, devoted to the 'General History of Birds,' contains a description of the general characters of the class and of the plumage.

The Plant World for February contains 'A Botanical Ascent of Mount Kataadin, Maine,' by John W. Harshberger; 'Another Trip to Glen Burnie, Maryland,' by C. E. Waters; 'Botanizing in Winter,' by C. F. Saunders, and 'A Primrose at Home,' by F. H. Knowlton, besides the usual and numerous notes and briefer articles which contain much of interest. In the 'Families of Flowering Plants' Charles L. Pollard concludes the description of the orders Opuntiales and Myrtifloræ and commences that of the Umbellales.

The Museums Journal of Great Britain for February contains an article on 'Museum Statistics,' intimating that it is desirable to know just how they are obtained, whether by estimate or by actual record. J. G. Goodchild presents an article 'On the Arrangement of Geological Collections,' and there is a sharp bit of criticism on some recent 'British Museum Appointments' in the entomological section. The subject of 'Hygiene as a Subject for Museum Illustration' is continued, showing the proposed arrangement of the divisions water, soil and personal. There is a large number of notes.

The American Museum Journal for February presents a review of the current work of the various departments and their more notable accessions, which include a good collection of mammals from Alaska, a fine skull of the woolly rhinoceros (*R. tichorhinus*) and a good series of butterflies from the Australasian region. This month's supplement is the Guide

Leaflet, describing 'The Collection of Minerals.'

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 549th regular meeting was held March 15, 1902. The evening was devoted to a discussion 'On the Definition of Some Modern Sciences.'*

Dr. W. H. Dall opened the discussion with a reference to the early history of the Society, when all the scientific men of Washington belonged to it, and the splitting up into numerous societies had not begun. He quoted some of the definitions of science from the earliest English dictionaries, and in felicitous words welcomed the speakers who had been invited to follow him, and characterized their subjects.

Col. Carroll D. Wright spoke on 'Statistics.' The name is due to Achenwall, Professor at Göttingen about 1750. It may be considered either as a method, or as a science demanding a classification of facts. Numerous fallacies in the collection and use of statistical data were illustrated, and attention was called to the importance of the psychological element in the interpretation of such data; thus, it was found that nearly all the farm mortgages in 1890 were evidences of prosperity rather than of adversity.

Professor Roland P. Falkner, now in charge of the Document Division, Library of Congress, discussed 'Economics.' The limits of a science, he said, are largely questions of the division of labor. So definitions vary, but the consensus of opinion is that economics deals with man in his activities, which are designed to satisfy his material desires, in short with wealth. From an analysis of his wants the metaphysical side of the subject has been developed. His wants being unlimited and nature's provision being limited, man must put forth effort; the character of this effort and the rules which govern it are the subject matter of political economy. The form which economic organization assumes at any time and place depends upon the abundance of land, labor and capital: whatever the form, the 'economic man' seeks the maximum result with the minimum effort. The axioms then of the theoretical or deductive economists are the limitations of nature's gifts, and the economic man. The newer school of inductive economists concerns itself minutely with the affairs of the past as well as the present, and is known also as the historical school.

Professor Edward A. Pace, of the Catholic University, spoke on 'Psychology.' He pointed out that the subject is now in a transition state. The older psychology, based on introspection, was inductive, but dealt only with mental operations. The newer science has three methods or fields of research: It investigates the relations between mental and physical phenomena, the development of mental life, and abnormal psychic phenomena. There is a striking parallelism between many psychic and physical phenomena, and one of the great questions of the science is regarding a causal nexus between the two groups.

Dr. Lester F. Ward, speaking for 'Sociology,' defined it as the science of society or of social phenomena. It is based on the study of large groups of men, not of individuals. Tylor's ethnographic parallelisms prove a uniform law of psychic development; primary wants are the same and are similarly supplied everywhere; governments and religions have more in common than in diversity; history is everywhere the same except the names. Sociology can be a science only as it depends on phenomena; and these are due to causes. These causes may be grouped as (1) environment (climate, nature of country, etc.) and (2) subjective environment or character. The old doctrines of free will made man a lawless being, not a rational one. The law of parsimony runs through all life.

Charles K. Wead,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 352d regular meeting was held on Saturday evening, March 22.

W. C. Kendall presented some 'Notes on the Sticklebacks,' briefly sketching the habits and habitats of these little fishes and stating that in spite of their insignificant size they occurred at times in such vast numbers as to be used for fertilizer, as food for cows and

* To be published in the *Popular Science Monthly.*

dogs, and even for man. They were taken in large numbers in the brush weirs used for catching small herring on the coast of Maine, and in the same locality often became a nuisance by clogging the nets of the smelt seiners. The speaker then discussed the synonymy of the group at some length, stating that while he had at his command but few specimens from Europe, there seemed to be three species distinguished by varying conditions of body armature and caudal keel. These were *Gasterosteus aculeatus, G. semiarmatus* and *G. gymnurus.* The Pacific forms had been disposed of by Rutter as *G. cataphractus* (Pallas) (possibly the same as *G. aculeatus*); *G. microcephalus* Girard, and *G. cataphractus williamsoni; G. microcephalus* being considered as merely an intermediate form.

On the Atlantic coast there seemed to be no intergrading of species and Mr. Kendall considered that for the present these should stand as follows: *Gasterosteus aculeatus* Linnæus, *G. cuvieri* Girard, *G. atkinsoni* Bean and *G. bispinosus* Walbaum. This last was widely distinct from *G. aculeatus* and was not the *G. bispinosus* of Jordan and Evermann.

W. H. Dall gave some 'Notes on Trophon,' in which he traced the history of the genus *Trophon* of Montfort, which is of distinctly Purpuroid affinities and had long been confused with the Fusoid group named by Sars *Boreotrophon,* but which the speaker showed would have to take the earlier name of *Neptunea* Bolten.

The typical Trophons are chiefly austral in their distribution, but Mr. Dall has discovered that a certain number of species have succeeded in migrating northward until they have reached the North Temperate Zone. An interesting group of these occurs on the coast of California, but the more northern migrants are stunted and inconspicuous.

E. S. Steele gave an account of 'The Vegetation of Stony Man Mountain, near Luray, Virginia,' being a summary of observations made during August and early September of 1901. Nine conifers were noted, the most interesting being *Abies Fraseri,* the Fraser balsam fir, of which this may possibly be the farthest outpost northward. *Juncus trifidus,* sparingly known so far south, was collected on the peak. An apparent form of *Cyperus Houghtoni* with few flowers to the spikelet was found on a high headland of rock, and near it was a patch of *Arctostaphylos Uvaursi,* both plants far out of their supposed range. On the same ridge occurred *Astragalus Carolinianus,* unexpected at this altitude. *Anychia divaricata* Raf., a species long neglected, was studied in connection with *A. dichotoma,* and its independence vindicated. *Solidago Randii* Britton, a supposedly northern species, was found on all high ledges. Data were given concerning a species of *Lacinaria* believed to be the true *Serratula pilosa* Ait. *Aquilegia coccinea* Small and *Aronia atropurpurea* Britton, recently described species, were reported, as also the rather recent *Rubus raribaccus* Rydberg and *Vitis Baileyanus* Munson.

F. A. LUCAS.

TORREY BOTANICAL CLUB.

AT the meeting of the Club on February 26, the first paper was by Dr. John K. Small, on the 'North American Genera of the Cassiaceæ,' and will soon appear in print. Discussion followed regarding *Poinceana,* participated in by Dr. Britton, Dr. Underwood and Dr. Small.

The second paper, by Dr. Arthur Hollick, on the 'Flora of Provincetown, Mass.,' was accompanied by a series of maps, charts, views and mounted plant specimens. Dr. Hollick discussed the dependence of this flora upon the local geology, and remarked of Cape Cod that the older part from Highland Light through Truro has a surface of glacial drift; the recent part, through Provincetown to the north and west, consists of drifted sands, all post-glacial, derived from the older coast to the south and due to the general trend of the tides and currents northward. The result is to form a line of shoals along the coast now united into an outer beach; the space between this and the shore is now filling in and becoming swamp, and a new outer line of shoals is already forming. Nothing larger now grows on the sand-dunes than small stunted pines and oaks; but Bradford's account indicates that in 1620 it was covered with large

deciduous trees. Acts to prevent further cutting of timber were passed in 1720, etc. At present the town of Provincetown forbids passing out of certain beaten paths in the wooded district, to prevent further loosening of the sand. Hundreds of acres have been replanted by the state, the lands of Provincetown having been successively reserved as common property of the colony, province and state; it is only within a few years that the land in actual occupation in and near the town has been granted by the state to the occupants. In reclaiming the sands, *Ammophila* or beach grass has been planted first, then bayberry, then *Pinus rigida*, the native pine of the region. Sand-loving species have since become well established as an undergrowth, but the new growth shows no sign of ever equalling the original. The same is true at Block Island, where the original forest had become established while the island was connected with the mainland. The sand flora is remarkable for the great areas closely covered with *Arctostaphylos Uva-Ursi;* this, with *Rubus hispidus* and some plants of *Corema Conradii*, is the chief means of forming the sand into turf. The species collected in Provincetown numbered ninety-four, among which *Corema Conradii* seems not to have been recorded from that town since Thoreau's visit in 1849.

The third paper was a note by Mr. A. P. Anderson on 'Tuckahoe or Indian Bread.' A specimen was exhibited, a mass about two feet long, made up of seemingly annual additions indicating ten years' growth. Similar specimens have been found in the South along roots of oak and other trees, usually about two feet below the surface, obtained chiefly when clearing land of old stumps. Undoubtedly a fungus growth, and probably a *Sclerotium*, it has never been seen to produce spores. The whole substance consists of a septated mycelium with abundance of white pectose. Europe contains the same species, and another in China has been used there for many centuries in medicine. Experiments by Mr. Anderson showed that portions separated from the roots of the host plant were alive in the soil after a half-year. Where the cortex was removed it was renewed.

A note by Rev. L. H. Lighthipe followed, with a communication from Mr. C. L. Pollard regarding his new species *Viola Angellæ*. He exhibited a water-color showing its spring and summer forms of leaf. An excursion for its collection about the Orange Mountains was suggested.

Edward S. Burgess,
Secretary.

THE LAS VEGAS SCIENCE CLUB.

At the regular monthly meeting, held February 13, Mr. E. L. Hewett presented the results of some studies of Navajo blankets, with special reference to the origin and meaning of the designs. Two blankets were exhibited which showed the Suastika design, which seemed to be especially prevalent among the Navajos, and not to have been derived from the older blanket-makers, the Pueblos. Unfortunately the most modern blankets were less beautiful and less interesting than the old ones, because the introduction of diamond dyes had led to the use of many inharmonious colors, and the makers also seemed frequently careless or ignorant of the meaning of the symbolic figures, employing them in a haphazard way.

T. D. A. C.

DISCUSSION AND CORRESPONDENCE.

SONG IN BIRDS.

To the Editor of Science: Two articles on song in birds have recently appeared in Science, from the pen of Mr. W. E. D. Scott, of Princeton University.* The first of these, at least, has been widely read and freely quoted, and as an amateur bird observer I do not like to see such widely influential work passed by without comment, so I beg to offer a few criticisms.

In the first article, Mr. Scott raises the question as to how the song of each bird originates—whether it is inherited or acquired by some sort of education. He then details an experiment which was carried on, evidently with great care, for a period of nearly five years. Finally, he draws from his experiment

* Science, October 4, 1901, p. 522, and January 31, 1902, p. 178.

the reasonable conclusion that "two birds, *isolated from their own kind and from all birds,* but with a strong inherited tendency to sing, originated a novel method of song, and that four birds, *isolated from wild representatives of their own kind and associated with these two, who had invented the new song,* learned it from them and never sang in any other way." This piece of work seemed to show such carefulness in experiment, in observation, and in the conclusion drawn, as to deserve the highest commendation, and it raised the hope of good work to follow.

But this hope was not fully realized in the sequel. The second article is devoted to cases of birds having acquired new notes in various ways. Some of the statements in this paper are of value, but some show a very insecure foundation. For example, Mr. Scott quotes from Miss Emily B. Pellet, in *Bird Lore,* what he considers a 'well-attested case of talking in a wild rose-breasted grosbeak. But a critical examination of Miss Pellet's article leads inevitably to the conclusion that the grosbeak was not talking at all, it was simply giving bird notes, and imagination put into them the likeness to human speech. This is indicated by the clear, musical character of the notes, by the peculiar non-human accentuation, and by the fact that the words were not repeated in parrot-fashion, but were freely rearranged in different sentences. Even if it were proved that the bird talked, it would be utterly unreasonable to conclude that it had learned to talk while a wild bird; the natural supposition would be that it had learned in captivity and had then escaped. The over-credulity of Mr. Scott in this case leads us to doubt the other examples he cites from unknown observers—those of the whistling and talking of canaries, and that of a duck imitating the call of a turkey. It is most important to know *how close* is the imitation in each case, for there is no subject on which popular evidence is so worthless as on the subject of mimicry. The crudest resemblance in appearance or in sound may be exaggerated into a case of 'perfect' imitation. We can find as much as we choose of this sort of evidence of mimicry.

As to Mr. Scott's own observations, there is one statement to be criticized, and that is that some birds reproduced the *direction* of a sound. What can this mean? It shows that Mr. Scott is not familiar with the psychologic basis of ventriloquism, or he would know that the ventriloquist can not indicate direction by his voice, but only by using some means to attract the attention of the listener to the desired point. And as for birds, it is highly improbable that they ever attempt to indicate the direction of a sound. Direction may be suggested by purely extraneous causes, and an example of this kind fell under my notice last spring which so well illustrates the point that I think it worth giving. I was standing on the top of a bluff overlooking a river-bottom; trees grew thickly in the bottom-land and up the bluff till just over my head. I heard the song of a robin, now loud and strong and apparently almost overhead; then very faint, and coming, as it seemed, from the tops of the trees in the bottom-land. From the robin's habit of singing a loud strain and a faint one alternately, it seemed probable that there was only one songster in this case, but it was almost impossible, at times, to avoid feeling that there were two birds, one almost overhead, and the other below my position, in the tops of the trees by the river. By changing my position I was able to see the bird, and to see that the same bird sang both songs. It was on a branch which overhung the bluff, being between the two positions from which the sound had seemed to come. In singing loudly, it had seemed nearer to me than it really was. Now, if it had been nearer, it would necessarily have been in the branches which were more directly overhead, and therefore I seemed to hear the sound coming down from those branches. But when the song sounded far away, it seemed too far to come from the trees of the bluff, and therefore I was forced to think that it came up from those of the bottom-land below. The case of Mr. Scott's birds is undoubtedly explicable in some similar way. The birds imitated only the sound itself, and the faintness of the sound, or the faintness combined with other qualities of the sound, was associated in his mind

with surrounding circumstances so as to suggest the direction.

While the cases in which Mr. Scott was not critical enough in his work may be distinguished and passed over by the scientist, they may do a great deal of harm in another way —they offer a bad example to amateur observers. And the very excellence of part of Mr. Scott's work may become deleterious by increasing the influence of these bad examples. In reading the interesting nature books which are so numerous nowadays, it is a bitter disappointment to find, in one author after another, statements which are made without a secure foundation, and which therefore throw a shadow of doubt on all the assertions of that author. It will be truly deplorable if this sort of thing is to be encouraged by a specialist in ornithology in one of our universities. We expect that such a man will do much toward correcting the popular error, and will never contribute to it.

Wallace Craig.

Hull Zoological Laboratory,
March 4, 1902.

A GEOGRAPHICAL SOCIETY OF AMERICA.

Professor Russell's plan of a general geographic society (Science, January 31, 1901) is timely and deserves the careful attention of all the friends of geography in America. It is the very thing that is needed to unify the widespread interest which is daily waxing stronger in this country. A multitude of schools ask for a better presentation of geography, and urgent demands are made for teachers in the special fields of physiography and commercial geography. The universities have been slow in providing the training, and earnest teachers, making every effort to widen their margins and to increase their efficiency, have had great difficulty in finding the published material which will keep them in touch with what progress the specialists are making. Even the specialists have been slow to enroll themselves as geographers; their primary allegiance has been with the geologists, economists, botanists and the like. The field of general geography has never had adequate recognition by the very masters who have done most of the constructive work giving the general science body and impulse in this country.

It will mean much therefore if all this great headless body of earnest workers in the common field be given a head and a local habitation and a name. And if then all those persons of superior training and abilities be organized into a society having at heart the welfare of geography in the New World, its status and dignity; a warm interest in the furtherance of exploration, survey and charting of lesser known regions; the making of adequate monographs of restricted areas or topics and the publication of this high class work under conditions calculated to insure scientific and literary value; and if then with a right association of interests consequent wide distribution of published records be assured, we shall indeed have taken a long stride in advance toward a healthy establishment of geography, as a coherent body of interests, on the high plane it occupies in some of the countries abroad.

Such an organization as Professor Russell suggests will make all this growth possible. It is a far-sighted plan, too, to make the association wide enough to include both Americas. For if we include Mexico and the rest of Middle America we could have no good reason for barring the remoter parts of Latin America. There is a growing bond of interest between the various parts of the New World, a bond which every added year will strengthen more and more. It will be a wise plan to help this movement in every way; and here is an opportunity to create a common interest in a great subject in the whole of the western world.

To insure the high quality and standing of the Society, there is no doubt the qualification suggested by Professor Davis (Science, February 21, 1902) is essential. Let us have the first move made with care, and standards set so high that the dignity and authority of the Society will be at once established, and membership an honor and a privilege to be worked for. To this end the suggestion of Mr. J. Stanford Brown (Science, March 14, 1902) is pertinent, that is, let us have two classes of membership, one the active, voting members, who, by the way, may be called 'fellows,' and

the other, the associate, or corresponding members.

The dues may be so assessed as to assure the quality of the publication, and the form of association with local societies may be so arranged that a slight addition to the local dues will make the local member an associate of the general society, and permit him to receive its publications at a reduced rate.

If the monthly magazine be kept at the high standard which we wish to see, it will be possible to have a salaried editor with training such as to assure the success of the magazine, and if the high standard be maintained, it will not seriously interfere with the local journals. There will be an audience for each quality.

As to the title, perhaps it will be permissible to make a different arrangement of the words which are necessary to properly describe the Society—for instance, the Geographical Society of America. But whatever the title, the idea is right, and the time is ripe, and if Professors Russell and Davis will take the lead, we shall yet have a general society in working order in time to welcome the International Congress in 1904.

J. PAUL GOODE.

UNIVERSITY OF PENNSYLVANIA.

THE WORD 'ECOLOGY.'

TO THE EDITOR OF SCIENCE: It is a good example of the well-known fact that the dictionaries—even the best of them—do not quite keep up with the progress of the language, which Mr. White has found in his search for the word 'ecology' (SCIENCE, March 28, p. 511). In its older form—œcology—this word occurs in the 'Century' and 'Standard' and no doubt in the other dictionaries referred to. The word was formally brought to the attention of American botanists in the Madison Botanical Congress, held in Madison, Wis., August 23 and 24, 1893, where the anglicized spelling was recommended and adopted. This action was in accordance with the well-known usage which drops the *o* in similar words, as in *economy* (instead of the older *œconomy*), *ecumenical* (*œcumenical*), *edema* (*œdema*), etc. The word ecology has been in quite general use in the botanical world for the past eight years, and in its older form it has been known in certain German biological works for at least a quarter of a century. It appears indeed that Ernst Haeckel first used the word, in his 'Generelle Morphologie,' as long ago as 1866.

CHARLES E. BESSEY.

LINCOLN NEBR.,
March 31, 1902.

IT is stated by a correspondent in a recent issue of SCIENCE that the word 'ecology' is not in the dictionaries. The word 'œcology' will, however, be found, so spelled in accordance with its etymology. It is only after words become universally known that these diphthongs are dropped, *e. g.*, paleontology, but we still have æsthetics, archæology, etc. I took pains, however, to have 'ecology' put in the Supplement to Webster; with a cross reference to 'œcology.' LESTER F. WARD.

TO THE EDITOR OF SCIENCE: In the issue of SCIENCE for March 28, you ask for information respecting the word ecology. Under the guise of œcology, it is in quite common use among biologists, and is in fact used by many as a substitute for biology or rather a special phase of it. For example, what is called by many the biology of insects is called by others the œcology or ecology. Œcology and œcological can be found in any recent dictionary; ecology and ecological are the same words with the substitution of *e* for *œ* in accordance with analogy exemplified by economy, economical, etc., which were formerly spelled œconomy, œconomical, etc. The words in their new guise will appear in the supplement to the 'Standard Dictionary.' THEO. GILL.

COSMOS CLUB,
March 28, 1902.

TO THE EDITOR OF SCIENCE: In reply to your inquiry in SCIENCE of March 28 (page 511) concerning the word ecology, it is to be said that the word occurs in the 'Century Dictionary,' but spelled œcology. It was coined by Haeckel in 1866 (in his 'Generelle Morphologie der Organismen'), but has come into general use only within the past few years. In Germany it is still spelled Œkologie, but in

this country it is always ecology. It signifies the science of the adaptation of organisms to their surroundings, a field of study in which botanists have been more active than zoologists. Ecology is prominent in every elementary botanical text-book published recently in this country, and every schoolboy if taught by a modern teacher, knows something of it.

W. F. Ganong.

Northampton, Mass.,
March 29, 1902.

The dictionaries are well acquainted with *œcology*, but have not yet discovered the change to *ecology*. This is clearly an oversight, for they are usually glad to aid in the improvement of spelling.

G. K. Gilbert.

[Many other letters have been received pointing out that the word 'œcology' is to be found in the dictionaries. If it did not occur to our correspondent, who is the editor of the New York *Evening Post*, that 'ecology' should be looked up under 'œcology,' it would not to others unacquainted with the term or its etymology; and he appears to have supported his main contention, which was that technical terminology is a serious difficulty in the way of reading scientific literature by those who are not experts in the given science.—Editor.]

CURRENT NOTES ON METEOROLOGY.

FOG IN SWITZERLAND.

As a thesis for the degree of Ph.D. at the University of Bern, Gotfried Streun has published an elaborate report on the fogs of Switzerland (4to, Zurich, 1901). The observations used as a basis for this study were made in 1897 and 1898, and the work was carried on under the supervision of Professor Brückner and of Dr. Billwiller. The lowlands have a maximum of fog in the morning, as a result of the nocturnal cooling of the lower atmosphere, while the mountain summits show a comparatively uniform distribution of fog through the day. A weak afternoon maximum at the latter stations is due to the formation of cumulus clouds in the ascending valley winds. The annual period of fogs is well marked in the lowlands and lower valleys, where there are autumn and winter maxima, but on the mountain summits there is hardly any trace of annual periodicity. As regards the average duration of spells of foggy weather, it appears that single days with fog occur most frequently at the lower levels, where the periods of greatest length come in fall and winter. On the Säntis the longest periods of fog come in spring and summer. At these altitudes continuous fogs frequently last for more than twenty days, while on the lowlands a fog of eight days' duration is a rarity. The general weather conditions under which lowland fogs are formed in winter are distinctly anticyclonic, while those accompanying high-level fogs are distinctly cyclonic, in both summer and winter. In connection with his study of the conditions of fog occurrence, the author finds confirmation of the Hann theory of cyclones. Numerous charts accompany this monograph. They show the frequency of foggy days, and the occurrence of fogs during a remarkable foggy spell from October 26 to November 25, 1897. The effect of topography on the development of fogs is strikingly brought out by these charts.

HAIL PREVENTION.

In the Report of the Chief of the Weather Bureau for 1901 (Annual Reports, Department of Agriculture) Professor W. L. Moore makes a protest against the spread in the United States of the popular delusion that destructive hail storms can be successfully prevented by cannon-firing. Some little time ago Drs. Pernter and Trabert, the well-known meteorologists of the Vienna Observatory, were invited by the Austrian Department of Agriculture, and by the inventor of one of the methods of cannonading, to study the conditions and results of the bombardment on the ground. The investigation which was carried out was as complete as it was possible to make it, and the sum and substance of the report was that nothing positive could be said as to the value of the shooting. Scientific men who cannot visit the scene of the cannonading themselves, and who need any authority for their doubt as to the efficacy of the 'hail shoot-

ing,' may safely accept the conclusions reached by Pernter and Trabert.

NOTES.

AN article on 'The Making of Australia,' in the *Scottish Geographical Magazine* for March recalls the fact that in the early days of exploration in the interior of Australia the discovery of an inland sea was reported. The news was naturally hailed with delight, but further exploration soon showed that no such sea existed. The deception had been caused by a mirage.

FOR November and December, 1901, the *Monthly Bulletin* of the Philippine Weather Bureau appears for the first time in English as well as in Spanish. In the December number there is an account of the earthquake of December 15 at Manila, with a facsimile (natural size) of the curves traced by the Cecchi seismograph.

THE Weather Bureau has recently issued a new edition of its 'Instructions for Voluntary Observers.' This useful pamphlet contains instructions for the erection, use and care of maximum and minimum thermometers and of the rain-gauge; instructions regarding the keeping of records, and a brief discussion of the proper uses of several terms which are often misused, *e. g.*, hurricane, tornado, whirlwind, etc.

A SECOND edition of Eliot's valuable 'Handbook of Cyclonic Storms in the Bay of Bengal,' embodying all the latest results, has been published. The first edition was dated 1890.

R. DEC. WARD.

HARVARD UNIVERSITY.

JOHANN VON RADINGER.

THE obituary notices of Johann von Radinger, who died November 20, 1901, are appearing in the European scientific journals.

Radinger was born July 30, 1842, in Vienna. His education was secured at the Technischen Hochschule, where he became assistant to Professor von Burg before completing his course, and, later, 1867, adjunct to Professor Grimm von Grimburg. He was promoted in 1876, and was made Professor des Maschinenbaues in 1879. In 1891 he was the Director of that great school of engineering, and at his death, his record within its walls extended over a period of thirty-four years. In 1895 he was made President of the Osterreichischen Ingenieur and Architektenvereines.

In all this long professional and scientific career, Radinger exhibited talent, even original genius, industry and great power of achievement. But his spirit was of that lofty and broad and clear-sighted character which, as in the case of nearly every man of genius, while splendidly working in a chosen vocation, could still find opportunity and strength for those avocations which attract all men of mind. He was interested in art, in literature and in all the sciences. He kept himself abreast modern progress in all these departments of human activity. He even found time to do some purely literary work, and his dramatic poem, 'Das Weib des Polykrates,' was produced under most trying circumstances. His genius was recognized by both state and private honors. The Order of the Iron Crown was conferred upon this engineer and man of science as the highest tribute the government could pay to his merits as a man and a public-spirited citizen.

He combined, as do so many men of his profession, practical knowledge and high attainments in applied science with an intimate acquaintance with the pure sciences. He found occupation for a time with Cail at Paris in practical manufactures and, as Konstrukteur, himself directed important interprises. He performed his full share of the great work of his time in the reduction of the art of machine-construction to a scientific system. He was particularly fruitful of good work in the development of the theory and the scientific method of design and construction of details of mechanism, interesting himself particularly in the great work of his generation of making the heat-engine, and especially the steam-engine, an embodiment of the theory and the art, in applied thermodynamics and in applied mechanics. He was a successful leader in the substitution of the exact methods of science in these fields for the old 'rule-of-thumb' ways, in the conversion of the vocation of engineer-

ing into a profession demanding learning as well as experience.

Largely under his energetic direction, the legal enactments of the empire for the provision of safeguards in the operation of steam-engines and boilers took correct form and he was appointed to important positions under the laws enacted to secure their proper enforcement. He taught his classes and he taught his public with equal fruitfulness and zeal. He was a teacher of the most admirable sort, exact, clear-sighted, endowed with that imagination without which no teacher can instruct and no investigator can either advance or help others to advance in research, friendly and patient, ambitious and aggressive, enduring and persevering, a leader always in the front rank and always beckoning from the van, never pushing his men on from the rear. He accomplished a notable life's work as instructor, investigator and author.

In personality, Radinger was interesting, attractive and impressive. The writer, as colleague on the International Juries at Vienna and at Philadelphia, 1873–1876, became greatly interested in the quiet, yet earnest and enthusiastic, scholar, philosopher and teacher. Inquiring into every detail of the, to him, astonishingly numerous wonders of invention and construction in the 'Yankee sections'; noting each device, its form, proportions and special construction and finish with the greatest care; comparing its dimensions with its work and the relation thus established by its designer with that usual in his own country; studying the methods of piece-work and of manufacture by production of interchangeable parts; excited over the marvelous watchmaking illustrated at the Centennial, or, after the jury had adjourned for the day, wandering in the art galleries and the halls of sculpture, or into the exhibits of the great publishers in search of interesting text or fine bindings, the broad grasp and unbounded intellect of the man were always revealed.

He was one of those generous men who, at the Vienna exposition, admitted the right of George Corliss to the 'Ehren Diplom,' although not a steam-engine of his make was exhibited. Radinger, von Grimburg, Reuleaux, Tresca, Dwelshauvers, Hartig, Schneider of Creusot, and a few others, advocated the highest award to the great American inventor, as they agreed, on the ground that the proof of his genius and of his enormous usefulness to the world was to be found in every section in the whole exhibition; every section contained one Corliss engine, and often several exhibits illustrated the work of the great mechanic.

The teacher, the man of science, the man of affairs, the investigator and author, the noble, kindly, generous and judicial man, will dwell in the memories of all who knew him and will be mourned by his colleagues and his friends as long as they live. His works will long remain, monuments to his life, his labors and his achievements. R. H. Thurston.

SCIENTIFIC NOTES AND NEWS.

The spring meeting of the Council of the American Association for the Advancement of Science will be held on Thursday afternoon, April 17, in the Assembly Hall, Cosmos Club, Washington, D. C.

Dr. Alexander Agassiz, who is now in Europe after his expedition to the Maldive Islands in the Indian Ocean, will return in time to preside at the meeting of the National Academy of Sciences which will be held at Washington next week.

Dr. James E. Russell, dean of Teachers College, Columbia University, has returned from a tour of inspection of the school system of Porto Rico, made at the invitation of the Porto Rican government.

Last year the Misses Caroline and Olivia Phelps Stokes placed in the custody of the New York Botanical Garden the sum of $3,000, the interest to be employed in efforts to preserve our native flora. The income for the current year was disposed of in the form of three competitive prizes, of $50, $30 and $20 respectively, for the best essays on this subject. The first of these prizes has just been awarded to Dr. F. H. Knowlton, editor of *The Plant World*. Dr. Knowlton's essay is printed in the March number of the *Journal* of the New York Botanical Garden.

MR. SHERBURNE W. BURNHAM, clerk of the U. S. Circuit Court since 1892, has resigned his position to devote his time to astronomy. Mr. Burnham was senior astronomer at the Lick Observatory in California when he accepted the Federal court clerkship.

DR. W. F. DREYFUS, assistant in chemistry in Columbia University, has been appointed chemist to the Department of Public Charities in New York City.

DR. LEONIDAS H. LAIDLEY, of St. Louis, has been appointed medical director of the St. Louis World's Fair.

PROFESSOR VIRCHOW'S health is said to be quite satisfactory. The fracture of the femur has united, and he gets up every day, but it will be some time before he will be able to resume his university work.

M. SANTOS-DUMONT, the Brazilian aeronaut, is a passenger on the *Deutschland*, due to arrive this week in New York.

PROFESSOR SAMUEL L. PENFIELD, of Yale University, will lecture on April 22 under the auspices of the department of geology of Columbia University on 'Possibilities in Geography resulting from the Revival of an Ancient Method of Map Making.'

THE portrait of Benjamin Franklin, executed by Gainsborough at the time of the signing of the Treaty of Paris, and lately given to the University of Pennsylvania by the class of 1852, has been hung in the University Library.

A MEMORIAL bronze tablet has been placed on the Albany (N. Y.) Academy in memory of Joseph Henry, stating that his experiments in electricity were made in that building while he was acting as professor of mathematics.

THE death is announced of Charles Letourneau, professor of the history of civilizations in the Paris School of Anthropology, secretary-general of the Paris Society of Anthropology, and a member of the commission for preserving the Megalithic Monuments of France. Among Professor Letourneau's many noteworthy works may be mentioned: 'La sociologie d'après l'ethnographie'; 'L'evolution de la morale'; 'L'evolution du mariage et de la famille'; 'L'evolution de la propriété'; 'L'evolution politique dans les diverses races humaines,' and 'L'evolution juridique dans les diverses races humaines.'

JOHN M. D. MEIKLEJOHN, professor of the theory, history and practice of education at the University of St. Andrew's, is dead. He was the author of many works, including a translation of Kant's 'Critique of Pure Reason.'

THE British National Physical Laboratory was formally opened on March 19. Sir William Huggins, president of the Royal Society, presided, and addresses were made by the Prince of Wales, Lord Rayleigh, Lord Kelvin and others.

THE Dudley Observatory at Albany, N. Y., recently celebrated its fiftieth anniversary, an address being made on the occasion by Mr. Lewis Boss.

A CABLEGRAM has been received at San Francisco, stating that the U. S. Fish Commission steamship *Albatross* arrived in Honolulu on March 24. The vessel is under command of Commander Chauncey Thomas, U. S. Navy, and has on board Dr. C. H. Gilbert, J. C. Snyder, and W. K. Fisher, of Stanford University, and Professor Nutting, of the University of Iowa, who will make a collection of fishes and marine vegetation. Very rough weather was encountered on the trip. The *Albatross* spent several days dredging and sounding. She will remain in port about six days, and then continue her exploring expedition around the different islands.

MR. ZENAS CRANE, of Dalton, Mass., has announced his intention to give Berkshire County a Museum of Natural History and Art. The building will cost $40,000, and Mr. Crane will give his collection of natural history and works of art, valued at $20,000.

MR. ANDREW CARNEGIE has offered to erect a public library at Havana at a cost of $250,000 on his usual conditions. The municipal council has voted to send a letter to Mr. Carnegie saying that it had been informed that he would give Havana this sum for a public

library, provided that the city would give land for the building and guarantee $25,000 a year for improvements and the maintenance of the library. The letter will also say that the council has decided to give a site for the proposed library, and that it accepts the provisions attached to the gift, but that the law does not allow it to bind the action of future municipal councils in matters of this kind.

The Blue Hill Meteorological Observatory is being enlarged, at a cost of five thousand dollars, by the construction of a fire-proof library, which will contain Mr. A. L. Rotch's valuable and rapidly increasing collection of books, pamphlets and periodicals relating to all branches of meteorology.

The Goldsmiths' Company will commemorate the coronation of King Edward by contributing £5,000 to the fund of £130,000 needed for the plan being elaborated by the conjoint board of the Royal Colleges of Physicians and Surgeons for investigating the causes, prevention, and treatment of cancer. Mr. H. L. Bischoffsheim has offered to contribute £5,000 to the fund, and another donation of the same amount, as well as other smaller sums, have been promised.

The Government of Queensland has offered a reward of $25,000 for the invention of some satisfactory means for destroying the 'prickly pear.'

At the (1900) Annual Meeting of the Society for the Promotion of Agricultural Science it was decided to elect the officers by the postal system. Each member should nominate persons to fill the offices, which are: president, secretary-treasurer, one member of the executive committe. Members are also requested to nominate candidates for membership, with full reference to valuable work performed, and, if possible, secure testimonials from other members. The next meeting will be held at Pittsburg, Pa., in conjunction with the American Association for the Advancement of Science; the first session will be called at 3 o'clock p. m. on Monday, June 30, 1902. Replies should be addressed to the President, Professor W. H. Jordan, Geneva, N. Y.

The New York University Chemical Society has recently been organized by the students, with Edward T. Hendee, 1900, *President;* Arthur E. Hill, 1901, *Vice-President;* and Franklin D. Byxbee, 1902, *Secretary and Treasurer.*

At the monthly general meeting of the Zoological Society of London on March 20, Dr. R. Broom, Dr. Carl Chun, M. Philippe Dautzenberg, Colonel Brian Mahon, C.B., D.S.O., and Dr. A. Donaldson Smith were elected corresponding members. It was stated that there had been 73 additions made to the society's menagerie during the month of February, amongst which special attention was directed to a fine young male snow leopard from Ladakh, presented by Captain H. I. Nicholl, and to a pair of Prjevalsky's horses from Western Mongolia, received on approval and new to the Society's collection.

It is reported from Washington that the plan which started at the beginning of the present session of Congress as a proposal that the president should recommend, and congress create, a department of industries, seems to have been revived within a little while in another form. The department of commerce is in a fair way to become an accomplished fact; and in the course of procuring the necessary legislation for it, there has been shown a desire on the part of many of the scientific experts in the government's employ to have their bureaus grouped, instead of being scattered through several departments. There will be an effort to attach to the department of commerce act a clause giving the president authority to transfer from other parts of the service to the Department of Agriculture such scientific bureaus as appear to his satisfaction to be cognate to the work of this department. If this is not done, it may be attempted to attach a paragraph authorizing a commission, consisting of one senator and one representative, and possibly three scientific experts, to look into the question of grouping the scientific bureaus in the manner indicated; the report of the commission to furnish a basis for further legislation.

The third annual report of the Liverpool

School of Tropical Medicine has been issued. The despatch of Major Ross to Sierra Leone brings up the number of expeditions sent out by the school for purposes of medical research and sanitary measures in the tropics to eight. Among the students trained at the school in the past year were medical men from Canada, India, East Africa, Penang, Sierra Leone, Uganda, Germany, Belgium and Sweden. More than 130 cases of tropical diseases were treated at the school.

IT appears that Germany has determined to regard in the light of a 'present' from the Chinese government the astronomical instruments stolen by her soldiers from the Chinese observatory at Pekin. This view was set forth by Count von Bülow, the imperial German chancellor, in a speech delivered in the German Reichstag, a copy of which has been received in Washington. Count von Bülow said: "The instruments have not been restored because the Chinese government attaches no importance to their possession, and in reply to German inquiries it placed them at the disposition of the German government. Another consideration is that, in accordance with the peculiar views of the Chinese, the great mass of that people would have supposed that the instruments were restored by order of the Chinese government, which would have damaged German prestige in East Asia. The Dowager Empress of China, a very clever woman who understands the political situation, would have been distinctly offended, while the masses would have thought that Germany had sustained some terrible defeats. The instruments ought now to be placed in the category of presents from government to government, which has long been customary on both sides in the intercourse with the Chinese government."

MR. STEVENS sold recently in London the collection of British lepidoptera formed by the late Mr. Philip Crowley. Among the more important lots were nine specimens of *Dispar*, or large copper, the now extinct British butterfly. These averaged £5 apiece, one female realizing £7. An assortment of exotic butterflies also realized good prices.

THE London *Times* says: There is on view in the library of the Royal Institution, an exhibit of the artificial dye stuffs produced by the Badische Anilin und Soda Fabrik, together with specimens of a great number of fabrics and materials, from silk to sealing-wax, to which they can be applied. Those who are interested in the bearing of technical progress abroad upon British industry will note the extraordinary range of colors produced from raw materials which are abundant in this country and of which English chemists first discovered the value. They will be not less painfully impressed by the excellence and variety of the artificial indigo dyes, the production of which now equals one fifth of the world's consumption and constitutes a very pressing danger for a great Indian industry.

IT is said that after prolonged experiments in sending four telegraphic messages each way simultaneously over a single wire, the German postal department has accepted the octuple transmitter invented by the late Professor Henry A. Rowland, of the Johns Hopkins University. The experiments were conducted between Berlin and Hamburg. Between 300 and 350 words were transmitted a minute. It is understood that the German postal department intends to introduce the Rowland system between Berlin, Hamburg, Cologne, Leipzig and Frankfort.

UNIVERSITY AND EDUCATIONAL NEWS.

THE daily papers have reported the remarkable bequest of the late Cecil Rhodes for education and the promotion of a good understanding between Great Britain, Germany and the United States. It appears that Mr. Rhodes has provided two scholarships for each state and territory of the United States and from each British colony, and for fifteen from Germany, the students to study at Oxford. The amount of the bequest is reported to be about $10,000,000, and the value of each scholarship about $1,500, but this appears to be uncertain. Mr. Rhodes also left £100,000 to Oriol College, Oxford.

Senator George F. Hoar, president of the board of trustees of Clark University, has made an announcement stating that Mr. Clark's will is absolutely settled, and that the income of the whole bequest, amounting to $2,600,000 will, in a few months, be at the disposal of the trustees, with the exception of $400,000 and the estate on Elm street, which Mrs. Clark holds for life. The sum of $500,000 has already been paid over to start the collegiate department.

Teachers College, Columbia University, has received an anonymous gift of $250,000 for the erection of a gymnasium.

An assembly hall to cost $50,000 will be erected at Haverford College by Mrs. Charles Roberts, in memory of her late husband, who was an alumnus and for thirty years a member of the board of managers of the college. She will also present to the institution Mr. Roberts's collection of autographs, valued at $50,000.

Two anonymous gifts, one of $5,000, another of $10,000, have recently been made for the new medical laboratories of the University of Pennsylvania.

Mayor Low has approved the bill providing for pensioning the supervising officers and teachers of the College of the City of New York. The amount to be set aside each year is 1 per cent. of the excise fund, or about $50,000.

The building which has been in process of erection for some years past in the front square of Trinity College, Dublin, will be formally opened on May 30. The new building occupies one side of the square, and among other uses will accommodate the historical and philosophical societies and will provide a meeting place for graduates of the university. Of the total cost of the memorial the sum of £8,500 was subscribed by the graduates.

The court of governors of the University College of Wales, Aberystwith, have decided to extend the chemistry department at a cost of about £5,500 and to call a joint conference of college and county authorities with the view of establishing an experimental farm. Upon the question of a national museum for Wales, the governors decided that, having regard to the geographical and educational conditions of the principality, the objects in view would be best served by grants to libraries or museums of a national character in the three centers of university education in Wales.

Senator Deboe, chairman of the Senate committee to establish the University of the United States, submitted on April 1 an affirmative report on behalf of that committee on the bill to establish a National University. The bill is the one introduced by the chairman and differs from those introduced by Senators Depew and Wellington chiefly in that it lessens the number of regents and raises the standard of admission for students in the field of general studies so that they must already have such attainments as represented by the degree of master of arts, instead of bachelor, as under the other bills.

Announcement has now been made of the official program on the occasion of the installation of Dr. Nicholas Murray Butler, as president of Columbia University, on April 19. The ceremonies will begin at 2:30 p.m. An address will be made by the chairman of the trustees, who will present the keys and charter of the university and the president will respond. There will then be addresses on behalf of the faculties by Dean Van Amringe; on behalf of the alumni by Mr. R. Fulton Cutting, and on behalf of the students by A. B. A. Bradley, followed by addresses by President Eliot, of Harvard; President Hadley, of Yale; President Patton, of Princeton; President Harper, of Chicago; President Draper, of Illinois, and Commissioner Harris. President Butler will then deliver the inaugural address. In the morning there will be a reception to the guests, numbering over three hundred college presidents and professors, and the buildings will be open for inspection. There will be a luncheon in University Hall, and in the evening a dinner will be given to President Butler, at which President Roosevelt, Mayor Low and others will speak.

Dr. Frederick W. Colgrove has resigned the professorship of philosophy in the University of Washington, being seriously ill.